THURSDAY, JULY 15, 1915.

NEW BOOKS ON BRITISH BOTANY.

(1) *The Potamogetons (Pond Weeds) of the British Isles.* By A. Fryer and A. Bennett. Illustrated by R. Morgan. Pp. x+94+60 plates. (London: L. Reeve and Co., Ltd., 1915.) Price £5 5s. net.

(2) *Floral Rambles in Highways and Byways.* By Rev. Prof. G. Henslow. Pp. 294. (London: S.P.C.K., 1915.) Price 6s. net.

(3) *A Pocket Synopsis of the Families of British Flowering Plants.* By W. B. Grove. Pp. vi+49. (Manchester: At the University Press; London: Longmans, Green and Co., 1915.) Price 1s. net.

(1) STUDENTS of British Botany and workers in general on pond weeds will welcome the appearance, after many days, of the completion of the monograph on British potamogetons which is associated with the name of the late Alfred Fryer. The monograph presents the results of an intimate study in their native habitats and extending over many years, of the species of one of the most critical of genera. In his home at Chatteris, in the fen country, Fryer was especially well situated for observing at first hand a large number of forms of this remarkably variable genus, and the retirement in which he lived, though a matter of regret to his botanical friends, gave the opportunity for close and uninterrupted study. The critical notes which accompany his very full description of the species, varieties, and forms are evidence of his thorough and painstaking methods, and the great value of his work is enhanced by the large series of beautifully prepared specimens numbering many hundreds which he bequeathed to the British Museum, where, in the Department of Botany, they will form a permanent record available for future use.

To the few botanists who were privileged to know Fryer it will be matter for regret that a brief account of his life was not included in the volume which records the results of his botanical work; the two were so intimately connected. At any rate, some explanation of the genesis and course of the work was due. No reference is made to the fact that three parts containing 56 pages of text and 36 plates were published in 1898 (two parts) and 1900, and that a fourth part, edited by Mr. A. H. Evans from Mr. Fryer's MS. appeared, with 13 plates, in 1913. The work was completed by the issue in March, 1915, of a concluding part by Mr. Arthur Bennett, with an introduction to the whole and a key to the species.

It was fortunate that Mr. Bennett, a friend of and co-worker with Fryer, and a botanist whose knowledge of our pond-weeds is unequalled, was able to complete the work. The volume as it stands, though a connected whole, thus represents three portions—an earlier portion, including seventeen of the total forty-two species and hybrids, which had been completed and published by Mr. Fryer before his death; a second portion, the difficult *lucens* group, which Mr. A. H. Evans has been able to edit from Fryer's MS. and published notes; and a third portion dealing with the grass-leaved group for which Mr. Bennett is solely responsible.

The text is well arranged and remarkably clear, though there is some want of uniformity in matters bibliographical. The work of the artist, Robert Morgan, is left to speak for itself. It is no detraction from the value of Fryer's work to emphasise the importance of the coloured plates, the great majority of which were drawn by Morgan from living plants supplied by the author; and there is no doubt that Morgan's untimely death in 1900 was a leading factor in the cessation of publication. The omission from the plates of the name of the species is to be regretted.

Apart from its value as a purely systematic work, the volume is of special interest as indicating methods of study and as throwing light on questions of variation and species-status in aquatic plants.

(2) It is difficult to realise when looking through Prof. George Henslow's latest volume that the author was an active botanist before most modern workers in the science were born. There is a freshness and juvenility about the series of rambles which form the subject of his eminently readable chapters, and we congratulate Prof. Henslow on the mental vigour which he retains with his fourscore years. In a series of fourteen chapters with titles such as "Along a Road's Sides," "By Hedges and Ditches," "Through Marsh-land," "In the Water," and others similar, he has brought together an amount of information about our commoner plants in a manner intelligible to any reader who has a slight knowledge of botany. Some of the more striking features of the plants characteristic of the various habitats are described, and interesting notes on their natural history, such as pollination, methods of climbing, etc., and on their distribution and folk-lore, are given. As was to be expected, the author seizes every opportunity to emphasise his view of

the origin of plant-form and structure as a direct response to the stimulation of its environment. The book is well illustrated by blocks nearly all of which are old friends (though the source is rarely indicated; many are borrowed from Johns' "Flowers of the Field"). There are also a number of, generally poor, coloured plates.

(3) Mr. Grove's pocket synopsis of the families of British Flowering Plants is a systematic enumeration of the characters of these families arranged under their orders and larger groups, on the lines of the system adopted by Engler in his "Syllabus." It is carefully compiled and "is intended primarily to facilitate the determination of the families of British plants by students." Most students will, however, probably wish to proceed further than the family and will prefer to use handbooks already in existence which enable them to do this.

TEXT-BOOKS OF CHEMISTRY.

(1) *Intermediate Practical Chemistry for University Students.* By F. W. Atack. Pp. viii + 204. (London: Sherratt and Hughes, 1914.) Price 4*s.* net.

(2) *The Manufacture of Organic Dyestuffs.* By Prof. A. Wahl. Translated by F. W. Atack. Pp. xiv + 338. (London: G. Bell and Sons, Ltd., 1914.) Price 5*s.* net.

(3) *Outlines of Organic Chemistry.* A book designed especially for the General Student. By Dr. F. J. Moore. 2nd edition. Pp. xi + 325. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 6*s.* 6*d.* net.

(4) *Elementary Practical Chemistry for Medical and Other Students.* By J. E. Myers and J. B. Firth. Pp. viii + 194. (London: C. Griffin and Co., Ltd., 1914.) Price 4*s.* net.

(5) *A Text-book of Inorganic Chemistry.* Vol. i. Part i., An Introduction to Modern Inorganic Chemistry. By Dr. J. N. Friend, H. F. V. Little, and W. E. S. Turner. Part ii., The Inert Gases. By H. V. A. Briscoe. Pp. xv + 385. (London: C. Griffin and Co., Ltd., 1914.) Price 10*s.* 6*d.* net.

(1) THIS little volume presents in some respects an original method of treating practical chemistry. After the usual preliminary description of the wash-bottle and its applications, etc., a series of above one hundred little qualitative and quantitative experiments are introduced, the interpretation of which the student is expected to supply. These are excellent so far as they go, but an occasional grouping of the observed phenomena might have been introduced with advantage as a sort of sign-post to the student. The usual tables are, however, postponed until the student is conversant with "identifications" by the dry way. After a very full account of qualitative analysis by the wet way, which includes tests for the rare metals, a section is devoted to preparations of pure substances and to gravimetric and volumetric analysis. The book is, in short, a very useful compendium of practical inorganic chemistry, and for those who intend to become professional chemists it may be unreservedly recommended.

(2) This book on organic dyestuffs is a translation from the French of Prof. A. Wahl, who fills the chair of industrial chemistry in the University of Nancy. We have it on the authority of Dr. Knecht, who has written a short introductory notice, that it supplies a real want, and that it was, in fact, at his suggestion that "this excellent little book" was translated.

It deals essentially with the production of the dyes from the raw material, and includes an account of the distillation of coal tar and the manipulation of the intermediate products. It enters neither into the theory of organic chemistry nor into the application of the dyes to the fibre. The student is therefore recommended to equip himself beforehand with a substantial knowledge of organic chemistry. Moreover, the book does not profess to transform the student into a practical colour-maker, for few details of the actual manufacture or the character of the plant are supplied. We may presume, therefore, that he will receive the necessary practical training concurrently with the study of the text-book if he intends to enter this branch of industry. For we cannot conceive how any student of ordinary intelligence can commit to memory the description of such a variety of compounds, many of which possess highly complex formulæ, without some pegs of practical experimental work to hang his information on.

The publication of this little volume comes at an opportune moment, when it is highly desirable that the interest of young chemists should be stimulated in the direction of colour-making. It is noteworthy that at the end of the volume the list of books of reference which is given includes a substantial number of English and French, in addition to German authors.

(3) Dr. Moore's "Outlines of Organic Chemistry," published originally in 1910, has now reached a second edition. The new edition, whilst retaining the original character and arrangement, represents a thorough revision, and includes the description of a number of new substances of practical interest, namely, citric acid, the fulminates,

and the chemistry of rubber, tannin, and the cyanides. The book is sufficiently well known to need no elaborate description.

(4) The "Elementary Practical Chemistry" by Messrs. Myers and Firth is written mainly for medical students, who, according to the authors, have experienced a long-felt want of this particular kind of aid to practical work. The information, though neither new in substance nor arrangement, is selected in accordance with the syllabuses of most of the medical examining bodies in order, it is presumed, that the overworked medical student may not expend his energies in stepping beyond their well-defined boundaries. This remark is not made in any spirit of cynicism, for it is becoming more and more evident that, with the present overcrowded courses in other branches besides that of medicine, special instruction must be devised for particular classes of students.

We have no hesitation in recommending the book, not only to medical students but to any class of beginners, as a useful introduction to practical chemistry. It is divided into four parts; the first deals with chemical manipulation and a variety of preparations, the second with qualitative, the third with quantitative analysis, and the final chapter is devoted to organic analysis. We would submit two suggestions to the consideration of the authors, though, perhaps, they overstep the syllabus; to combine rough quantitative measurements with such preparations as the reduction of copper sulphate to copper or the preparation of quicklime from marble, to which they readily lend themselves. There seems no reason to wait until part iii. is reached. The second point is to modify part iv. so as to introduce a group of simple organic preparations before entering on the qualitative side of the subject. We confess to having our misgivings as to the value of this section.

Organic chemistry, as represented by organic compounds used in medicine, is not to-day what it was a quarter of a century ago, and the perfunctory testing of a few dozen of the simplest substances selected from the wide range of complex medical preparations now manufactured has neither an educational nor a practical value. It is, of course, not the authors, but the syllabus which is at fault, for the growing importance of organic chemistry for the medical man demands a much more intimate knowledge than most of the syllabuses are devised to meet.

(5) Dr. J. N. Friend, the editor of this new text-book of inorganic chemistry, points out that, whilst physical and analytical chemistry have been comprehensively dealt with in the form of text-books, inorganic chemistry can show no similar publication, and the present projected series of nine volumes is intended to fill the gap. Each volume is written by one or more authors, well known and accredited in the chemical world, so that the new volumes, so far as authorship is concerned, hold out every promise of success. That the series, if efficiently done, will be welcomed by those who can afford to purchase it, almost goes without saying; but it is to be feared that nine volumes at ten shillings and sixpence each will appeal more to public libraries than to private purses.

After reading through several chapters and dipping into others, the impression we have received is entirely favourable. The matter is not only well and thoughtfully arranged and clearly expressed, but (what is less common in the larger text-books containing great masses of condensed information) it is presented in an attractive, literary form. Whilst giving full weight to the many excellent features of the work, it is not, perhaps, irrelevant to inquire for what class of readers it is written. It is obviously not a work of reference, such, for example, as Dammer's "Handbuch." It is too big and costly to serve as a text-book for advanced students, though there is much that they might read with profit. The question, in short, is whether a big and expensive text-book affords the best means of conveying to a large number of readers the latest discoveries in a growing science like chemistry. It generally means the reiteration of a large amount of elementary matter, with an expenditure of space which could be more profitably applied to expanding the subject on its less familiar side.

To take an example from the present volume, a chapter on the classification of the elements leads naturally to the familiar facts of the periodic law, which is discussed at some length. Our interest having been stimulated up to this point, we come upon a paragraph entitled "Modifications of the Periodic System," in which we are informed that there is no space to discuss it, our curiosity having to be appeased with three-quarters of a page of references. The work of the Braggs on molecular structure, which is certainly among the most important contributions to the subject during the present century, is relegated to a footnote with numerous references, and there are many other examples of the same kind. It is as if we had been invited to take a journey into foreign lands, and, having started, had been presented with a Baedeker instead.

We are strongly of opinion that, with a mobile science, the system of cheap monographs, which

can without great cost be from time to time re-edited, would serve the more useful purpose of bringing the subject up to date, and of reaching, by reason of their cheapness, a larger number of readers than this more costly form of advanced literature, excellent though it may be. J. B. C.

THE PHYSICAL BASIS OF GEOGRAPHY.

Physical Geography. By P. Lake. Pp. xx+324. (Cambridge: At the University Press, 1915.) Price 7*s.* 6*d.* net.

PHYSICAL geography is already represented by numerous elementary text-books, and by other more ambitious works, most of which deal with particular branches of the subject. Mr. Lake's book occupies an intermediate position, being suitable for the needs of teachers and university students. The result is admirable, and the author is to be congratulated, not only on the accuracy of the subject matter, but also on the lucidity and attractiveness of his treatment.

The book is divided into three sections, dealing in turn with the atmosphere, the oceans, and the lands. The first of these is perhaps the most valuable, or at least calls for most praise, for climate and weather, being still imperfectly understood even by their special students, have afforded many a pitfall for the unwary writers of general text-books. Any attempt at undue simplicity is to be deprecated in the interests of accuracy, and Mr. Lake has steered a happy course between the temptation to describe ideal cases, on the one hand, and the danger of citing confusing masses of actual meteorological data, on the other. The author points out the desirability of planning a teaching-course so that the study of the atmosphere occupies the winter session, leaving the land to the summer months when field excursions can be taken.

In the section dealing with the oceans, the chapter on waves and tides should be particularly useful to the student, for these subjects are effectively handled with enviable ease. A chapter is devoted to coral reefs and islands, and the views of Darwin and Murray are presented, but no mention is made of Daly's recent contribution to the controversy, in which he correlates the formation of atolls and barrier reefs with the lowering of sea-level that accompanied the Pleistocene glaciation, and its subsequent rise as the ice melted (*Amer. Journ. Sci.*, 1910, p. 297). The chapters which treat of the land are uniformly good. They constitute a delightful exposition of dynamical geology, and one feels that they are all too short. The temptation to have written more must have been strong, for rivers, and glaciers, and volcanoes have a way of leading one further and further afield in the realm of earth-lore. Mr. Lake has written just enough in this, and in the other sections, to fire the student with interest, and no text-book can hope to achieve more.

The book is well illustrated with twenty plates, 162 figures in the text, and a series of maps illustrating isobars, isotherms and rainfall, those of the latter being coloured. Altogether it is a very refreshing text-book, and it has the advantage of satisfying a real need in the teaching of physical geography. ARTHUR HOLMES.

OUR BOOKSHELF.

Smithsonian Physical Tables. Sixth revised edition. Prepared by F. E. Fowle. Pp. xxxvi+355. (Washington: Smithsonian Institution, 1914.)

THESE physical tables, originally compiled by Prof. Thomas Gray in 1896, have been revised by Mr. F. E. Fowle, of the Smithsonian Astrophysical Observatory. The number of tables has been increased from 335 in the fifth to more than 400 in the sixth edition. The new matter includes a new set of wire tables from advance sheets supplied by the Bureau of Standards, mathematical tables compiled by Mr. C. E. Van Orstrand, and data relating to Röntgen rays and radio-activity. Thus we find a table giving Moseley's atomic numbers and the wave-lengths of lines in the X-ray spectra of the elements. We miss, however, determinations of the ratio of the charge to the mass of an electron. The mass of an electron is very nearly 9×10^{-28} grams, not 6×10^{-28} grams (Table 406). Sadler, on p. 336, no doubt through association with Barkla, becomes Sadla! It would be useful to have the value of the electro-chemical equivalent given for some elements other than silver. These, however, are minor blemishes, and actual use of the tables during two months has proved their great value. It is not too much praise to say that a copy should be in every scientific library and advanced physical laboratory. It may be of service to state that the volume may be obtained in Great Britain, where it should be more widely known, through Messrs. Wm. Wesley and Son, Essex Street, Strand, W.C., at 8*s.* 6*d.* net.

The Design of Steam Boilers and Pressure Vessels. By Prof. G. B. Haven and Prof. G. W. Swett. Pp. vii+416. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 12*s.* 6*d.* net.

THIS book is a comprehensive treatise on the design of steam boilers and other vessels subjected to internal fluid pressure. The subject naturally divides itself into questions of strength, of providing dimensions suitable for the thermal operations involved, and the production of working drawings embodying the results of the calculations. The authors have endeavoured to harmonise the rational methods of both theory and practice;

wherever possible results have been found by rational rather than empirical methods. The design of a steam boiler, so far as strength is concerned, is a matter in which the designer has but small latitude. In this country he has generally to make the results of his calculations conform to the rules of the Board of Trade, or of Lloyd's Committee, or of both. Hence the book will be of greater service to the student than to the practical designer, although there is much in it which will appeal to the latter also.

Naturally much reference has been made to the Massachusetts Boiler Rules, which have been used as a model by many States and adopted bodily by others. It is of interest to note that, with certain exemptions, these rules provide that all boilers shall be inspected when installed and annually thereafter by the inspection department of the district police, under supervision of the chief inspector of boilers. In this country the periodic inspection of land boilers is left to the owner, who generally delegates the matter to his insurance company. If the boiler is not insured, periodic and competent inspection may, or may not, be carried out, and depends entirely on the owner's workmen or engineer.

The book is well illustrated and contains several fully worked out designs. These, and the methods of calculation, are of considerable interest and will be of service to engineers in this country who wish to acquaint themselves with up-to-date American practice in boiler design.

Mechanical Drawing, with Special Reference to the Needs of Mining Students. By J. Husband. Pp. 79. (London: Edward Arnold, 1915.) Price 3*s.* net.

READERS of this excellent text-book will have a feeling of satisfaction that a piece of good work, evidently much needed, has been conceived and carried out in a thoroughly efficient manner. Teachers and students connected with mining and colliery engineering are much indebted to the author for putting at their disposal, in a convenient form, material which will specially appeal to them and will prove most helpful in the drawing classes and an incentive to study.

The course is progressive, beginning with some excellent advice on the selection and manipulation of drawing instruments. The well-executed drawings are fully and clearly detailed and dimensioned, and the descriptions are always suggestive in pointing out the leading features of a design, and are models of conciseness and lucidity.

The examples selected are welcome on account of their freshness, importance, and suitability. In order to give an idea of the scope of the work we may instance the plates on bolt and rivet fastenings; built-up work, such as stanchions, girders and pump quadrants; pedestals, shafts and axles for wagons and winding engines; mine cages and colliery tubs; haulage clips and safety hooks; mine pumps; pneumatic hammer drills.

We strongly recommend teachers of elementary machine drawing to consult this most useful manual.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Use of Cotton for the Production of Explosives.

WHILE in no way attempting to dispute the authority of the writer of the article on gun-cotton in NATURE of July 1, I should like to take the opportunity of expressing my surprise at the conclusions there reached. On general grounds one would anticipate that plant-products, such as cellulose and alcohols, could be prepared in any country, so long as plants grew; they stand in sharp distinction from metals and petrol, which are not of universal occurrence.

It scarcely seems likely that the suitability of cotton as the cellulose basis for certain explosives can be due entirely to chemical peculiarities, for although cotton is a typical cellulose it contains many impurities —mineral salts, dead protoplasm, cuticle, waxes. These cannot all be entirely removed in course of manufacture, and it is presumably their presence which necessitates the very careful blending employed in preparing cotton for nitration. It seems more likely that the matter is one of physical properties, the thin-walled, hollow, pitted cylinders of the cotton hairs offering a large surface to reagents.

But if this were the prime advantage of cotton, it is not one which need inhibit the use of other forms of cellulose for the making of "gun-cotton." Even the best cotton is by no means uniform from hair to hair, and the waste cotton used for nitration is still more irregular; consequently, it seems likely that an artificial cellulose might be made even more uniform than cotton. It would scarcely be possible to make such a product with the same ratio of surface to mass as is found in natural cotton hairs, but this ratio could at least be made constant, *e.g.* by dissolving the cellulose and squirting thin threads of it, in the form of "artificial silk." The trade in these artificial silks is mainly Continental, and has been developing rapidly during the last ten years, so that there should be no lack of knowledge of the process in Germany.

Undoubtedly "gun-cotton" made in this way would be quite different from true gun-cotton. All values would have to be re-computed; the trajectory, with the sighting and timing, would be altered, and a great deal of extra work would be thrown on all concerned, but with all submission to the chemists, to whose domain this matter belongs, I venture to think that it may be *possible* to turn out perfectly uniform "gun-cotton" with cellulose derived from plants other than cotton. The question of cost is immaterial in the circumstances, and although it cannot be doubted that the cutting off of Germany's cotton supplies would hinder the German guns, yet it seems likely that a fairly effective substitute might be devised by the nation of technologists.

Carlyle may be quoted in this connection. "Interrupted Commerce and the British Navy shut us out from saltpetre; and without saltpetre there is no gunpowder. Republican Science again sits meditative. . . . What of saltpetre is essential the Republic shall not want." W. LAWRENCE BALLS.

Little Shelford, Cambridge, July 7.

I HAVE read not only with interest, but also, I hope, with some instruction to myself, the admirable letter from Mr. Balls which you have been kind enough to let me see. I am entirely in accord with him in his

view that as long as plants grow so long will cellulose be formed, and with this as a basis nitro-cotton can certainly be prepared. I do not wish to convey the idea that the reason why cotton waste is chosen for making nitro-cotton is its chemical idiosyncrasies, but rather that it is the most abundant and fairly uniform stuff which is available for practical use. Mr. Balls is quite right in thinking that the physical structure of cotton fibre has much to do with the applicability of cotton for making propulsive explosives, but this cuts both ways, because even cotton is troublesome in that those fibres tend to retain acid, which has to be removed by regulated boiling and washing. Hence the suggestion that an artificial "cotton" might be used is well worth considering—dissolved and squirted cellulose being necessarily fairly uniform—and I agree with Mr. Balls that it would not only be possible but also tolerably easy to turn out perfectly uniform gun-cotton made this way.

Nobody has denied from the beginning of the discussion which has taken place in the Press on the subject of cotton for explosives, that nitro-cotton can be prepared from any source of nature which can provide us with cellulose, but the issue is really rather different. It is impracticable for a factory accustomed to using a particular raw material so to alter its operations as to use another raw material without great delay, expense, and in this case much danger. The other difficulty has been mentioned by Mr. Balls, and is that of the artillerist who, given even a better nitro-cotton than that to which he is accustomed, would have to learn his art all over again, and meanwhile it is of more advantage to his country that he should be sighting his gun in the manner to which he is accustomed. To use a homely expression, it is generally a mistake to swap horses in crossing a stream.

THE WRITER OF THE ARTICLE.

The Great Aurora of June 16, 1915.

THERE have been comparatively few auroras here of late years. In that time we have passed through the aurora minimum. Lately, however, there have been distinct indications of an awakened activity in the frequent appearance of auroral glows and arches. But these were generally feeble, and at best showed very little in the way of streamers or other signs of activity.

The night of June 16 was very clear throughout, and gave us one of the finest displays of the aurora that I have seen. Before the moon set there was a very strong, low-lying arch in the north. This was not active, but its intensity seemed to suggest the possibilities of a great display.

At 15h. 30m. G.M.T. the arch was very low and flat, and extended a great distance towards the east and west. There were no streamers.

At 16h. 10m. there were no streamers, but there was considerable action underneath the arch in the way of brightening masses. At 16h. 50m. the arch was double in its eastern part, the upper portion extending to the lower part of Cassiopeia.

By 17h. 10m. the aurora was very brilliant and active, the arch having risen and spread all over the north, nearly as high as the pole. The lower part of the arch was broken with bright moving forms. A few minutes later the arch had risen above the pole, while below it there was very little auroral light except a few streamers. By 17h. 30m. the aurora had quietened down, and the great spasm, seemingly caused by the rising of the arch, had subsided, with the exception of some great bright masses in the north-west, where the remnants of the arch had drifted.

By 18h. 13m. a low, strong arch, slightly active, had again formed in the north. The new arch soon rose and also became double.

By 19h. 43m. the arch was breaking up, and very long streamers were ascending everywhere. By 19h. 52m. quick waves of light were ascending towards the zenith, succeeding each other with remarkable rapidity. These waves continued without intermission until dawn blotted them out about 21h. 5m.

After about 19h. 40m. the display rapidly increased in magnitude, and attained its maximum splendour at about 20h. 10m. or 15m., when it became too bewildering to describe. The whole heavens seemed alive with flickering and dancing light. The rapid waves of light and the streamers were ascending in all directions, even from the south, to a focus that appeared to be on or near the meridian and about 20° south of the zenith. (Its declination was roughly +23°.) This focal spot was occupied by some of the irregular luminous masses which were momentarily brightly illuminated by these waves. The streamers were no longer slender rays; they were now broad sheets of light along which the ascending waves raced with intense rapidity, giving them the appearance of flames rushing up from the horizon to and beyond the zenith. These quick light waves momentarily and brightly illuminated every object over which they passed. The sky was full of wisps and curved streaks of luminous matter over which the light waves took a sensible moment to pass. This produced a remarkable effect. As the light ran from end to end of them the rapid brightening seemed to give life and action to these streaks and produced in them a writhing and darting motion which they did not possess, for their real motion and change of form was quite sluggish. As late as 21h. 25m., when the sky was bright with dawn, some of the great bright masses were still visible in the north-west.

There was but little colour in the display at any time, though some of the streamers and masses assumed a slight pinkish tinge at about 19 hours. Efforts were made several times to form curtains at the bases of masses of streamers, but no regular curtains were actually formed.

Throughout the night I was photographing with the Bruce telescope. As frequently as possible notes were made of the progress of the aurora. At 20h. 0m. the sky was so brilliantly lighted that I was forced to close the exposure. The resulting negatives were badly fogged with the auroral light, which seemed to be more actinic than moonlight.

The present aurora was much like that of 1903, October 30 (see *Astrophysical Journal*, vol. xxxi., p. 212), in its phenomena and its effects on the telegraph systems, but exceeded it in some respects.

From the newspaper accounts we learn that the aurora was visible over the greater part of the United States and Canada. It was strong even in California.

A despatch to the *Los Angeles Tribune* of June 18, from Spokane (Washington), dated June 17, says:—

"Electrical currents caused by the aurora borealis almost stopped telegraph service in northern Idaho, Montana, and the Dakotas between midnight and 1 o'clock this morning. Up to 9 o'clock this morning the Western Union Telegraph Company reported interrupted service, but not to such a great extent as in the hour following midnight."

In the *Chicago Tribune* of June 18 a despatch from New York, dated June 17, says:—

"Following the spectacular appearance last night of the aurora borealis, which lighted the entire north-west, came reports to-day of crippled telegraph and cable service. The effect of the electricity from the northern lights was felt on wires in a zone stretching across the continent, and as far south as Pittsburgh.

"Across northern Idaho, Montana, and the Dakotas service virtually was suspended. Like unsatisfactory conditions prevailed on all the northern transcontinental lines.

"For several hours during the early morning cable communication *viâ* the Newfoundland cables of the Western Union was all but paralysed."

During the progress of the aurora, Mr. Frank Sullivan and Mr. E. P. Hubble, of this observatory, tried the wirless receiver here, with which time-signals are received from Arlington, Virginia, Mr. Sullivan at 14h. 45m., when the arch was strong but not active, and Mr. Hubble at 20h. 0m., when the greatest display occurred. They found in both cases that the static conditions were normal. Mr. Sullivan reports that it was unusually quiet. E. E. BARNARD.

Yerkes Observatory, Williams Bay,
Wisconsin, June 25.

The Magnetic Storm and Solar Disturbance of June 17, 1915.

A CORRECTION is necessary for the value of 1′ of arc displacement for the H.F., given in my letter published in NATURE of June 24. It should read, line 18 ($1' = 4{\cdot}0 \times 10^{-5}$ C.G.S. units). There is also an ambiguity in the preceding line, in the use of the word displacement. The extreme values of the greatest oscillation in the H.F. about 4.15 p.m. amounted to 100′, as stated, but the maximum displacement was 76′, the value of the base line being 24′.

In his very interesting letter on this subject (NATURE, July 1), Dr. Chree mentions several dates on which sudden movements of the magnets occurred, which are presumably of cosmic origin. It may also be of interest to compare the state of the solar surface on these dates with these sudden movements. The first occurred at 1 p.m. on June 16. On this date the two sympathetic groups of spots, which I have associated with the magnetic storm of June 17, evinced considerable disturbance, the faculæ in the neighbourhood of these two groups, as also bright faculæ conjoined with two other groups nearer the E. limb, showing a decided drift towards the south. On June 18, as already described in my last letter, the whole of the region between these two groups was violently disturbed, and the faculæ, which must have been very bright to be visible in the middle regions of the sun, showed the same southerly drift. As this was visually the most disturbed region of the sun, and, moreover, it was near the heliographic position of the earth, it seemed most likely that this region was the one connected with the magnetic storm, if any such direct connection exists.

On June 14 a bright compact patch of faculæ appeared in the N.E. quadrant on the sun's limb, in which were a few small dots. This new disturbance continued to grow, until on June 21 it had developed into a fine group of large spots near the central meridian. Its mean approximate position was +17° latitude, and 356° longitude. This region was also much disturbed on June 19. Dr. Chree directs attention to the considerable magnetic disturbance which commenced at 3.10 p.m. on June 21 with a sudden movement of the H.F. magnet. Dr. Chree also mentions another sudden commencement on June 7 "of considerable size at a time when Father Cortie tells us the sun was almost free from spots." On that date there was only one group of very small spots at mean latitude +21° and longitude 198°, in a ring of faculæ. But I find on consulting our solar drawings that M. Henroteau, the observer, has made the following note on the drawing of June 8, with regard to this group of very small spots: "The region of the spots seems very disturbed."

Finally, that quiet magnetic conditions show the twenty-seven day period is not inconsistent with, but would naturally follow from, successive synodic presentment earthwards of an undisturbed hemisphere of the sun. A. L. CORTIE.

Stonyhurst College Observatory, July 4.

Use of Tyrosine in Promoting Organic Growth.

I DESIRE to direct the attention of readers of NATURE to the influence of tyrosine in promoting the growth and multiplication of any organisms that may be found in tubes five to ten months after they have been hermetically sealed and sterilised, as described in "The Origin of Life," second edition, 1913, and NATURE of January 22, 1914.

The June number of the Proceedings of the Royal Society of Medicine contains an illustrated communication dealing with the effects of this powerful auxetic when used in the form of a 0·05 per cent. solution. Its influence was tested on a large number of tubes ripe for examination, containing five different kinds of experimental solutions (the constitution of which is given) by adding, with all necessary precautions, about twenty drops of the tyrosine solution to each tube when it was opened. The tubes were then reclosed and replaced in the incubator for three to four weeks. When the contents of these tubes were reexamined after such an interval a very considerable growth and multiplication of unmistakable organisms were found to have taken place, thus tending to disprove the two principal doubts that had been urged against the original experiments by showing (1) that what were found were not mere pseudo-organisms; or (2) organisms which had pre-existed in the solutions, and had been killed by the sterilising process. Photomicrographs of the organisms taken from the tubes before, as well as after, the addition of the tyrosine show its great influence in favouring the multiplication of bacteria, torulæ, and moulds.

I have quite lately heard from the brothers Mary (Institut de Biophysique, Paris) that they have been similarly successful in obtaining from some of their tubes, after the addition of tyrosine, plenty of budding torulæ, as well as delicate spore-bearing moulds, and that they are about to publish an account of their investigation.

The last number of the Proceedings of the Royal Society (B. 609) contains an interesting paper by Prof. Benjamin Moore and W. G. Evans, in which they describe and figure some simple pseudo-organisms, of a kind with which I am quite familiar, obtained from a limited number of tubes containing solutions apparently similar to some of those which I have used. I have prepared and examined more than a thousand of these tubes, and among them have found many barren series. A comparison of their illustrations with mine will show that they have hitherto met with totally different objects. It is true, however, that some of their finds, under the low magnification which they employ, have a superficial resemblance to matted or twisted hyphæ of moulds (see especially Figs. 1, 7, and 11).

The simplest solution from which I have obtained different kinds of moulds, and which I can recommend to others, is one made from 10 per cent. solutions of iron sulphate and potassium ferrocyanide, in which one drop of the former and two of the latter are added to each 30 c.c. of distilled water. The iron stock

solution changes colour somewhat after a time, owing to oxidation of the ferrous salt, as Sir Wm. Ramsay tells me, and the moulds found in solutions prepared from fresh stock fluids and from others one or two months old have been of a different kind. The remarkable mould of Cladosporium type referred to in a note to my paper was found in each of a series of tubes the solutions of which had been prepared from stock fluids one month old. An examination of the stock fluids themselves, even after three months, does not reveal moulds of any kind.

H. CHARLTON BASTIAN.

Fairfield, Chesham Bois, Bucks, July 9.

Napoleon and the University of Pavia.

THE following allusion to Napoleon having spared the University of Pavia in 1804 on account of the memory of the illustrious man of science, Spallanzani, who had been a professor there, is so interesting at the present time that I venture to bring it under the notice of readers of NATURE.

The passage is from Baron's "Life of Dr. Edward Jenner" (vol. ii., p. 35), which was published in 1838:—"He who flushed with victory and at the head of the revolutionary army of France had spared the University of Pavia out of respect to the genius of Spallanzani when the city itself was given up to plunder, proved that the claims of science were not forgotten amid the astonishing events which carried him forward to the highest pinnacle of ambition. His animosity to England had been shown in that vehement and decided manner which marked all his actions; yet there was one chord of sympathy unbroken which, when duly touched, showed that his intoxicating success had not raised his proud spirit beyond some of the calls of justice and humanity, and that he could still be moved by the peaceful arguments of truth and science."

Napoleon's conduct in regard to the ancient University of Pavia is in striking contrast to that of the Kaiser in regard to the University of Louvain. The Germans, in their own opinion, are pre-eminent in the subject of the history of medicine, and yet it has been reserved for Germans to destroy the University of van Helmont, the father of chemistry, of Vesalius, the father of anatomy, of Schwann, the originator of the cell-theory. Further comment seems unnecessary.

D. FRASER HARRIS.

Dalhousie University, Halifax, N.S., June 19.

A New Tsetse-Fly from Zululand.

THE Durban Museum has lately received from Mr. R. A. L. Brandon, the magistrate of Ubombo, Zululand, a tsetse-fly captured by him in the court-house at Ubombo, towards the end of March, which is very distinct from the ordinary Zululand species, *Glossina pallidipes*, Austen, and apparently belongs to an hitherto unknown form.

It is a member of the *palpalis* group, and seems most nearly related to *G. tachnoides*, Westw., but the markings on the abdomen are not so strong or so sharply defined, and the dorsum of the thorax is buff. It is a female, and measures 8 mm. in length, exclusive of proboscis. In honour of the captor it may be known as *Glossina brandoni*.

It is my intention to give a detailed description in the next number of the "Annals of the Durban Museum."

E. C. CHUBB.
(Curator).

Durban Museum, Natal, June 16.

MUNITION METALS.

IN this article an attempt is made to compare briefly the resources of the Allies and the enemy countries in respect of metals which are regarded as essential for War purposes.

First in order of importance comes iron, the basis of the modern gun, armour-plate, armour-piercing projectile, shrapnel shell, high-explosive shell, and all the varieties of steel which find application in one way or another. Both sides have a sufficiency of iron ore and the accessories required for smelting, although the deposits in the enemy countries are inferior in quality to those possessed by the Allies. An illustration of this is furnished by a comparison of the amounts of acid and basic steel produced in Germany and Great Britain in 1913—the last year for which the complete figures are available. Germany's total steel production for that year was just under 19,000,000 tons, of which 96 per cent. was made in basic-lined furnaces; Great Britain's output was 7,663,000 tons, of which only 36 per cent. was made by the basic process. Both countries, however, imported considerable quantities of Swedish pig-iron, which is used for the manufacture of steels of the highest class, *e.g.*, tool steels, and Great Britain also imported substantial amounts of Spanish hematite ore, which was smelted with the clay ironstone ores of the Cleveland district, which are low in iron, and contain, for the most part, more phosphorus than is compatible with the transformation of the resulting pig-iron into steel by any acid process.

The production of open-hearth steel from pig-iron—and such steel provides the casing of the high-explosive shell and the shrapnel shell—demands, however, a second and very important metal, namely, manganese, which in the form of ferro-manganese or silico-spiegel is used not only to de-oxidise the fluid steel, but to leave from 0·5 to 1·0 per cent. manganese in the finished product. The chief producers of marketable manganese ore in order of importance are Russia, India, and the United States of America, which in 1913 furnished about 93 per cent. of the total quantity mined. The raw material is pyrolusite, a "straight" manganese ore corresponding when pure to MnO_2. The main supplies of pure ores, therefore, are in the Allied or neutral countries. In 1913 Germany imported about 670,000 tons, chiefly from Russia. The figures of her domestic production in 1913 are not available, but in 1912 her output was 90,980 tons, while that of Austria-Hungary was 16,540 tons in 1913.

In spite of these figures there is no sufficient reason for concluding that the enemy countries will be greatly hampered even if all external sources of supply are shut off, as they probably are. Confining our attention to Germany, the predominant partner, it must be pointed out in the first place that 4,300,000 tons of her steel production in 1913 were exported, and that except in so far as Austria-Hungary and Turkey are concerned this excess would be available for her own

munition needs if she could obtain sufficient manganese. In the second place, the last-named metal is relatively widespread and occurs in many minerals. It is only the limited demand and the abundant supply of high-grade ores to draw upon which have confined marketable ores to such products. The enemy countries will in all probability be able to supply their needs by mining lower-grade ores within their own territories, and their metallurgists will no doubt have been able to make the requisite changes in the technology of steel manufacture to meet the altered conditions—quite apart from any stores of pure ore that may have been accumulated before the outbreak of war, and apart from any substitutes that may have been discovered.

The case of nickel, however, is very different. It is an indispensable constituent of gun and armour-plate steel, and of the modern bullet and armour-piercing projectile. In all these instances its action is specific, and it is doubtful whether any satisfactory substitute is known. It is therefore a munition metal of the highest importance. The world's production of nickel in 1912 was about 26,500 metric tons (a metric ton equals 2204 lbs.). Of this, Canadian mines and smelters produced 85 per cent. in the form of a copper nickel matte (sulphide), 89 per cent. of which was refined in the United States and the remainder at Clydach in South Wales, with the production of the pure metals. New Caledonia supplied almost all the remaining ore required, this being shipped to Europe and smelted there. Judged by Canadian standards the Norwegian production of nickel was very small, the output in 1912 being only about 400 tons.

The position, therefore, is that fully 98·5 per cent. of the world's output of nickel ore was being produced in the Allied countries before the war broke out, and that the remainder was furnished by a neutral country. So far as Canada is concerned the situation was dominated by two companies, the International Nickel Co. and the Mond Nickel Co., while the production of nickel ore in New Caledonia was monopolised by two large French companies. The only nickel ores situated in the enemy countries are kupfernickel ($NiAs$), cloanthite ($NiAs_2$), and nickel glance ($NiS_2 + NiAs_2$). Each of them can be worked for the production of nickel, but how inadequate a source of this metal they were may be judged from the imports of ore and metal into Germany in 1913. In the first six months she imported 6643 metric tons of ore and 3416 metric tons of metal. (It is to be noted, however, that her exports of the same metal were 2409 tons in the same year.) The Norwegian nickel production may still be available for Germany, but this is nothing like enough for her requirements, and apart from pre-war stocks she will have to fall back on the above-mentioned native ores to furnish the requisite quantity of this metal.

Scarcely less important than nickel is the metal chromium, which, though it finds no application in the pure state, is an essential constituent of armour-plate, armour-piercing projectiles, and high-speed tool steels. Rhodesia and New Caledonia furnish between them the bulk of the principal chromium ore, chromite (an iron chromium oxide). Russia produces substantial amounts, while Greece and Asia Minor used to do so, though their output has diminished in recent years. It is more than likely that the requirements of the enemy countries are resulting in an increased output from the last-named countries, and it will be observed that even if Greece joins the Allies the Asia Minor supplies, which are sufficient, will still be open to the German and Austrian armament firms. Chromite is worked up into an alloy of iron and chromium (with or without carbon) known as ferro-chrome, and applied in this form to the production of the particular steel required.

All shells, whether shrapnel, high-explosive, or armour-piercing, are fitted with a copper band which serves a double purpose. It prevents contact between the shell and the gun-barrel, and, owing to its great ease of deformation under stress, accommodates itself to the very rapidly altering stresses set up in the tube after firing, making good contact with the rifling of the barrel, and thus preventing the rush of gas out of it in advance of the projectile. Before the war it was customary to use not pure copper, but an alloy containing a little zinc, as the material of the band, not because the zinc improved the properties of the copper, but because it was a cheaper metal, and a certain proportion of it could be used with only a slight sacrifice of ductility. Now that zinc has become much more expensive than copper there is no object in doing this. Copper is also the main constituent of cartridge brass and shell fuses, Admiralty gun metals, and high-tension hydraulic bronzes, so that from the point of view of both branches of the service it is a most important munition metal.

Of the normal annual world's output of copper —about one million tons—the United States of America produced 55 per cent. in 1913. They are by far the greatest producers of this metal. Next came Japan with 7·3 per cent., followed closely by Spain and Portugal, Mexico, Australasia, Russia, and Chile, each of which supplied between 5 and 4 per cent. Of the Allies Italy furnished 0·16 per cent., Great Britain 0·03 per cent., while France was a non-producer. Of the enemy countries Germany's output was 2·5 per cent., and that of Austria-Hungary 0·4 per cent. None of the belligerent countries except Japan supplied its needs from internal sources in 1913; all of them except Japan imported copper from the United States of America; in that year Germany took 137,000, France 71,400, Italy 18,500, Austria-Hungary about 17,000, and Great Britain 15,000 tons.

The Allies are able to take delivery of such copper as they need, thanks in the main to the British Navy, whereas the enemy countries have found it increasingly difficult to import this metal. The position probably is that they have succeeded in obtaining through neutral shipping and neutral countries more than is generally suspected, but nothing like enough for their war needs, more

particularly since Italy joined the Allied countries. In 1913 it is estimated that Germany's consumption was 265,000, and Austria-Hungary's 50,000 tons; their united production was 29,400 tons. There is no means of estimating the War demand for this metal in these countries, to which, of course, Turkey must be added. It is quite certain, however, that its use is being rigorously restricted to purposes for which there is no substitute, and it is extremely probable that large stores were accumulated before the war. The very high price that Germany has recently been willing to pay for copper shows nevertheless that her reserves have been considerably depleted. Two things may be stated with confidence. The first is that all her copper mines, mills, and smelters are being worked to their utmost co-ordinated capacity, the second that her technical metallurgists will have endeavoured to find a substitute for copper shell bands.

Aerial warfare has enthroned aluminium as *par excellence the* munition metal for this purpose, but its war usefulness is by no means confined to the construction of aircraft. One of the greatest metallurgical achievements of the last century was the adding of aluminium to the metals of everyday life. Thirty years ago the world's annual production was 5500 lb.; in 1913 it was estimated to be 173,175,000 lb. In this time it has risen from a rare metal to a yearly tonnage exceeded only by iron, lead, copper, zinc, and tin. To quote Prof. J. W. Richards ("Mineral Industry," 1913, p. 14):—"It can confidently be anticipated that by the middle of this century it will rank next to, or even ahead of, copper. It is already cheaper than tin, pound for pound, and cheaper than copper per unit of bulk or per unit of electrical conducting power, while the range of its applications and usefulness is extending more rapidly than that of lead or zinc."

One of the less well known uses of aluminium is as a constituent of the bursting charge for shells. "Ammonal" is an explosive the constituents of which are ammonium nitrate and finely divided aluminium. It is not a propellent explosive, such as cordite or other of the smokeless powders; its disruptive effect is too great, and its explosion too sudden. But this very fact renders it suitable as a bursting charge for shells, and Austria-Hungary is using it for filling the shells for the howitzer batteries. The United States and Canada produced nearly half the world's output of aluminium in 1913, the remainder being furnished in almost equal amounts by France, Great Britain, and Switzerland, leaving out of account a tonnage of 800 produced in Italy. So far as the Allies are concerned, therefore, they are in a much better position than the enemy countries with regard to the supply of this metal. Moreover, France contains the most suitable European deposits of the raw material of manufacture, viz., bauxite. The Swiss production is available for the enemy countries, and it is known that Germany has since the war become a producer of the metal.

Next there is zinc, the metal of which the selling price has appreciated to five times its pre-war figure. Originally only two-fifths the price of copper, it is now decidedly above it, in spite of a marked appreciation in the price of copper itself. The most important munition uses of zinc are as a constituent of cartridge brass and shell fuses, and as a covering for iron barbed-wire fencing. In 1913 the principal producers of the metal were the United States, Germany and Belgium; whereas, however, the first-named smelted domestic ores, the two latter relied mainly on zinc concentrates imported from the Broken Hill mines in New South Wales, where, owing mainly to the high price of labour, it does not pay to smelt the ore locally, or even in the country. France, Spain and Great Britain also produce substantial amounts, though not enough for their own needs. Although the importation of Australian ore into the enemy countries is now stopped, they have considerable supplies of local ore both in Silesia, Hungary, Carinthia, and Tyrol. Unfortunately for Great Britain her zinc-smelting furnaces are not well adapted for dealing with Broken Hill concentrates, and there are upwards of 80,000 tons seized in enemy shipping which are lying idle in our yards in this country. She is in the unsatisfactory position of having to draw upon the United States for the bulk of her supplies. The shortage of domestic zinc is bound to continue unless works are built and operated which are capable of dealing with the zinc concentrates from Broken Hill. It is therefore of national importance so long as the war lasts that the use of zinc, whether as such or for alloys, should be restricted to purposes for which this metal is absolutely necessary.

Lead calls for only brief mention. Germany is a very large producer, and her output with that of Austria is sufficient for the requirements of the enemy countries. Australia is the largest producer among the Allies, who, however, do not furnish enough for their needs, and draw upon the United States, Spain, and Mexico. The shrapnel bullet is a lead-antimony alloy, the antimony producing the requisite hardening and embrittling effect. In spite of the fact that the shrapnel shell is much less suitable than the high-explosive shell for the offensive land operations of the present war, the price of antimony has appreciated almost as much as that of zinc. The normal annual world's production is less than 20,000 tons, of which China furnishes two-thirds and France the bulk of the remainder. Before the war Hungary was producing about 800 tons per annum, but doubtless this amount could be substantially increased.

Tin as a constituent of tin-plate, the various anti-friction metals, solders, and Admiralty gun-metals, is a munition metal of no small importance, the world's normal annual output being about 120,000 tons. Of this the Federated Malay States produce about half from native ore, in addition to exporting ore which is smelted in various European countries; England comes next as a producer of the metal, although 75 per cent. of her output is derived from imported ores; then follow Banca, Germany, Australia, Billiton, and China in the order mentioned. The enemy countries have

hitherto relied on imported ores for raw material, their own deposits being very inadequate.

To sum up, the position may be stated broadly as follows:—Of the ten munition metals, the chief sources of production and uses of which have been passed in review, the enemy countries can certainly produce five without having recourse to imports, viz., iron (the basis of the various steels used for war purposes), manganese, chromium, zinc, and lead; on the other hand, it is doubtful whether they can produce sufficient nickel, copper, aluminium, tin, and antimony from domestic ores. In view of the fact, however, that they prepared for this war with extreme care and foresight, it may safely be concluded that large stocks, either of ores or the corresponding metals, or both, will have been accumulated in those countries. However confident the Higher German Command may ostensibly have been of a rapid victory, they will quite certainly have laid their plans to wage a prolonged war if it should prove to be necessary, and such plans will have included the accumulation of munition ores and metals of which their countries produced an insufficient amount. There is accordingly no adequate reason for concluding that the enemy countries are likely—in spite of the prodigious scale upon which the war is being conducted—to run short of metals which are *essential* for war purposes for some time to come. Moreover, it may safely be concluded that their technical metallurgists will have been mobilised in the direction of discovering substitutes for any of the above metals of which a shortage is liable to occur in a long war.

The Allies for their part can produce from their own resources all the iron, manganese, nickel, chromium, tin, and most of the aluminium they require; their command of the seas enables them to obtain, principally from the United States, their deficiencies in aluminium, copper, and lead; China furnishes the requisite antimony. Zinc is the only important munition metal of which there is a shortage, in spite of the great speed with which the American furnaces are being operated. Wherever it is possible to substitute zinc by another metal it is of national importance that it should be done.

It is satisfactory to note that on July 7 Mr. Lloyd George, in answer to a question in the House of Commons, stated that "the necessary steps have been taken to stop the export of lead, spelter (zinc), antimony, and nickel, and other metals necessary for the manufacture of munitions of war. The four metals named cannot be exported except to places in the British Empire."

H. C. H. CARPENTER.

THE PRODUCTS OF COAL DISTILLATION.

IN a paper before a conference recently held at Cardiff on the extension of British trade, Mr. W. J. A. Butterfield dealt with the many important aspects of this question, which has become of vital national importance to us now that supplies from Germany are cut off. We probably scarcely yet realise how dependent we have been on Germany for many raw and finished products; indeed with many coal tar derivatives it has amounted to a German monopoly.

The output of coal in the United Kingdom in 1913 was 287,430,473 tons; in Germany 188,485,000 tons, but in addition to the ordinary coal 86,093,000 tons of brown coal or lignite were raised. England retained 189,092,369 tons for home consumption in 1913; Germany retained about 155,503,000 tons and 93,455,000 tons of brown coal, part of which was imported. These figures show a mean consumption of coal of 4·108 tons per head in the United Kingdom and 3·68 tons of coal and brown coal in Germany. Broadly speaking, the coal consumption is a measure of the industrial activity of the two countries, and on this basis it is gratifying to note the greater consumption in England.

In order to arrive at some idea of the products available from distillation, the amounts of coal carbonised for gas and coke making, and the quantities treated in recovery plant in the latter case, must be considered. It is estimated that, in 1913, 37,483,944 tons of coal were used in the manufacture of gas and coke in this country; something above 16,000,000 tons being carbonised in gas works. In Germany the total quantity carbonised was 62,613,000 tons; only about 9,000,000 tons being used in gas works. There is, however, a difference of considerable importance so far as the utilisation of products is concerned, that whereas in the United Kingdom 42·7 per cent. of the total coal carbonised is treated in gas works, primarily for the production of coal gas, in Germany the corresponding figure is only 14·4 per cent., the larger bulk being treated primarily for the production of coke.

Owing to the larger proportion carbonised in ovens in Germany, the quantity of some crude products which are of primary importance in chemical industries—such as benzol, which is recovered only to a very small extent in gas works—is very much greater in Germany, relative to the total amount of coal carbonised, than in the United Kingdom. The output of pig iron, which dominates the question of coke production, is clearly an important factor. Germany derives a further advantage from the more extensive use of by-product recovery plant.

Benzol recovery is now a matter of national importance, since toluene, which forms from 10 to 25 per cent. of the benzol, is in large demand for the manufacture of trinitrotoluene. In recovery oven practice the gas is stripped of the whole of the benzol content, but in gas making only the toluene content of the benzol is removed permanently from the gas. It has been proved, however, that at least one-third of the benzol content of the gas can be removed without reducing its calorific value below the standard of 500 B.Th.U. per cubic foot. The possible supply from coke ovens, if the whole of the gas produced in them were debenzolised in recovery plant, would probably amount to 60,000,000 gallons; in

addition, by the removal of one-third of the benzol from coal gas, allowing the average benzol to be 2·25 gallons per ton of coal, another 12,000,000 gallons would be obtained. These supplies are independent of the small quantity in coal tar. Mr. Butterfield estimates that some 5 gallons of pure benzene and 1·5 gallons of pure toluene are obtainable from this source per 100 tons of coal carbonised.

Benzene, toluene and xylene, which are obtained from the heavier fractions of benzol and the lighter fractions of naphtha, are the raw materials from which many nitro-compounds are produced for the manufacture of explosives, and for the preparation of bases such as aniline, toluidine, xylidene, etc., which are the starting points for the manufacture of large classes of dye-stuffs and drugs. Congo red, indigo, the large number of aniline dye derivatives, fuchsine, and eosine, are among the most important of the derivatives of the benzene hydrocarbons. Nor must the heavier oils be overlooked. Phenols yield valuable disinfectants, and phenol itself is the raw material for the manufacture of salicylic acid, many dye-stuffs, and the important explosive picric acid (Lyddite). Naphthalene and anthracene are both important as parent bodies from which valuable dyes are prepared.

Referring to the production of trinitrotoluene, Mr. Butterfield mentions that great stores of this explosive had been accumulated in Germany prior to the outbreak of war, and that for one or two years prior to the commencement of hostilities its shipment to this country appears to have been hindered, on the ground of its being dangerous. Without a powerful detonator there is, however, no danger in shipment.

The problem of the establishment of the synthetic colour and drug industries in this country on a scale commensurate with our own requirements is considered briefly. The author sees no inherent objection to the directorate of such an undertaking consisting wholly of financiers and business men, providing that the control of the working is delegated to an advisory or managing board constituted of technical chemists, with at least one engineer accustomed to the design and supervision of works plant. These industries appear to offer ample scope for the investment of capital, with ultimate prospect of very high returns on the investment.

THE MANCHESTER MEETING OF THE BRITISH ASSOCIATION.

THE meeting of the British Association, to be held in Manchester next September, will present some novel and some exceptional features. The special encouragement that will be offered this year to the large class of students and teachers of the district in which the meeting is held, to join the association by offering them associates' tickets at a reduced fee is a novel feature which, if it proves to be successful, may be repeated in future years. The reduction in the number of days over which the meeting extends, the absence from the programme of the formal excursions to which the members are accustomed, and the omission of garden parties and some of the evening entertainments, are exceptional features which have been necessitated by the circumstances arising from the war.

After the outbreak of war some discussion arose as to the wisdom of holding the meeting at all this year. The decision to hold the meeting was reached after consultation between the council in London and the local executive committee. There was some difference of opinion, but, by a very large majority, it was decided that the opportunities afforded by the British Association for the discussion of scientific matters and for the conference of men of science are of such national importance, at the present time, that the meeting ought not to be abandoned.

At the same time it was felt—and on this point there was unanimity—that many of those features of the association's meetings which are of the nature of social entertainment and festivity would be out of place, and should be reduced to a minimum.

Since this decision was reached, great efforts have been made, under the leadership of distinguished men of science in the country, to organise the resources that British science affords for the most pressing services of the State. This organisation should include not only the branches of science that deal with the direct physical, chemical, and technological problems bearing upon the conduct of the war, but also with those that deal with the educational and economic changes the need for which the war has demonstrated. Proper organisation of our forces is undoubtedly essential, but no less essential is the provision of opportunities, such as the meetings of the British Association afford, for the public and private conference of our experts from all parts of the British Isles. It is anticipated, therefore, that the decision of the council and local executive committee to hold the meeting will meet with a hearty response from the scientific men of the country, and there is reason to believe, from the names that have already been sent in, that the meeting this year will prove to be one of the most interesting and memorable in the history of the Association.

The first important change in the arrangements that will be noticed is that the whole business of the meeting will be included in the week beginning September 6. The inaugural meeting will be held in the Free Trade Hall on Tuesday evening, September 7, and the final meetings of the sections on Saturday morning, September 11. For the first time in the history of the association, therefore, there will be no British Association Sunday.

Prof. Schuster, Sec.R.S., the president-elect, will deliver his address at the inaugural meeting on Tuesday evening, and in the same hall on Thursday evening Mr. H. W. T. Wager, F.R.S., will deliver a discourse on the behaviour of plants

in response to light, and on Friday evening Dr. R. A. Sampson, F.R.S., will deliver a discourse on a census of the sky.

On Wednesday evening the members and associates are invited to visit the Manchester School of Technology, and to inspect the appliances and apparatus with which this great institution is provided.

The reception room will be the Whitworth Hall of the University, and accommodation will also be provided for all the sections (except Sections F, L, and M), for all the committees, for writing rooms, smoke rooms, and refreshments within the University precincts.

For the convenience of men of business in Manchester, Section F (Economics) will meet in the Chamber of Commerce in Mosley Street. Sections L and M will meet in the High School for Girls in Dover Street, a few yards from the University buildings.

Although there will be no long-distance excursions of the usual type, some shorter excursions will be arranged of special interest to members of particular sections. There will be, for example, some afternoon excursions to places of geological interest for members of Section C, and some short-distance botanical excursions for members of Section K. Arrangements will be made for the visit of some of the members interested in antiquities to Ribchester to attend the formal opening of the new Roman Museum, and on another occasion there will be an excursion to visit the Manchester Ship Canal.

Opportunities will be afforded in the course of the week for members to visit some of the more interesting works, warehouses, and factories of the district, but, owing to the circumstances of the war, the great armament factories, some of the chemical works, and businesses engaged in the manufacture of munitions of war, are unable to offer this year similar invitations to the association.

The Rylands Library, Chetham Hospital, the Art Galleries, and other institutions of special interest, will be opened to members of the association during the meeting.

In the house of the Manchester Literary and Philosophical Society, members of the association will be able to inspect a series of original diagrams made by John Dalton at the beginning of the nineteenth century to illustrate his lectures on the atomic theory. These diagrams have quite recently been discovered in the premises of the society, and have been cleaned, catalogued, and displayed for the inspection of the members. In addition to these diagrams, visitors may see an interesting collection of the instruments, apparatus, and personal effects of John Dalton, and some of the apparatus used by J. P. Joule in his experiments on the mechanical equivalent of heat.

The association has arranged for a number of lectures by distinguished men of science for working-men audiences in Manchester and some of the neighbouring boroughs during the week. The programme of these lectures will be issued shortly.

S. J. H.

NOTES.

THE council of the Physical Society of London has decided to sanction and adopt the letters F.P.S.L. as the official indication of fellowship of the society.

WE regret to see the announcement of the death, at Pretoria, on June 28, aged forty-six, of Mr. Herbert Kynaston, director of the Geological Survey of the Union of South Africa; also, on June 6, at Calcutta, of Mr. H. S. Bion, assistant superintendent, Geological Survey of India.

THE second International Conference of the Society for Practical Astronomy will be held on August 16, 17, and 18, at the University of Chicago, Chicago, Ill., U.S.A. All persons interested in astronomy, and friends of the science, whether members of the society or not, are cordially invited to attend the regular sessions of the conference, and will be made welcome there. The programme will consist of papers from members, illustrated lectures on astronomical subjects, and social meetings. For at least two of the evenings excursions have been arranged to the Dearborn Observatory of Northwestern University, in Evanston, Ill., and to the (private) Petrajtys Observatory, in South Chicago, Ill.

THE death is announced of Prof. J. F. Eykman, of Groningen, at sixty-four years of age. After studying at Amsterdam and at Leyden, and qualifying as a pharmaceutical chemist, Prof. Eykman was appointed director of a hygienic and chemical laboratory at Nagasaki, Japan; later he became professor of chemistry in the University of Tokyo. In 1885 he founded, in the Buitenzorg Botanic Gardens, a laboratory for the chemical and pharmacological investigation of East Indian plants, but returned to Holland in the next year, being succeeded by the late Dr. M. Greshoff. Since 1897 he had occupied the chair of organic chemistry in the University of Groningen. Prof. Eykman was largely responsible for the compilation of the first Japanese Pharmacopœia. His name is further associated with the so-called depressimeter—a simple apparatus for cryoscopic molecular weight determinations.

EXETER COLLEGE, University of Oxford, which has already suffered a severe loss by the death of Dr. Jenkinson in the Dardanelles, has now been deprived of another of its members who had added to his work as a teacher the experience gained by investigation in a wider field. Capt. C. F. Balleine, a native of Jersey, entered Exeter College as a classical scholar in 1902. After a successful academic career, he took his degree in 1906, and was then elected to a senior scholarship in the same college "for travel and research." Having spent some time in Germany, he joined Dr. Randall MacIver in an archæological investigation at Korosko in Upper Egypt. His work on that site was cut short by an attack of appendicitis, on recovery from which he returned home. Having been elected to a tutorial fellowship, still at his old college, he devoted himself assiduously to promoting the welfare, both mental and physical, of the students under his charge. Always keenly interested in military matters, he was a most efficient officer in the Oxford O.T.C. Soon

after the war broke out he obtained a commission as captain in the Rifle Brigade, and went to the Front in April. On July 2 he was killed by a shell in Flanders, to the great grief of all who knew him. It is unfortunate that his opportunities for original work were not greater. There is little doubt that, had circumstances favoured, he would have attained high distinction in this direction.

THE joint session of the Aristotelian Society, the British Psychological Society, and the Mind Association was held on July 3 and 5. On July 3 Prof. Dawes Hicks presided, and an interesting discussion took place between Prof. G. F. Stout and Mr. Bertrand Russell. It was opened by a paper in which Prof. Stout criticised adversely the theory of judgment as a multiple relation put forward by Mr. Russell in "Problems of Philosophy" as a solution of the problem of truth and error. Mr. Russell now declared that he was himself dissatisfied with the theory and could not defend it, though not for the reasons brought against it by Prof. Stout. He still found himself in profound disagreement with the latter on the fundamental question of the nature of universals. On July 5 Prof. Percy Nunn presided. The meeting was devoted to the discussion of a symposium on "The Import of Propositions," by Miss Constance Jones, Prof. Bosanquet, and Dr. Schiller.

THE greater part of a very large skeleton of the Pleistocene southern elephant (*Elephas antiquus*) has been discovered in a river terrace in the grounds of the Royal School of Military Engineering at Upnor, near Chatham. The specimen was buried in stiff clay, and all the remains are well preserved except the comparatively fragile skull. By permission of the War Office and the commandant of the school, and with the valuable help of Capt. H. L. Bingay, the geological department of the British Museum (Natural History) has been engaged for some time in excavating the skeleton, and the work is now nearly completed. One of the preparators of the museum, Mr. L. E. Parsons, has hardened and packed the bones under the direction of Dr. C. W. Andrews, and the collection will shortly be sent to the museum for final preparation. The skeleton is so nearly complete that it can probably be mounted, when it will rival, if not exceed in size, the great skeleton of *Elephas meridionalis* in the Paris Museum, which measures about 14 ft. in height at the shoulder.

THE Ipswich Museum has for some time past made a very strong feature of the department of prehistoric archæology, and has collected extensively from the uniquely rich district of East Suffolk. The museum collections now include a large and representative series of pre-Palæolithic and Palæolithic flint implements, and also numerous examples of specimens referable to the later Cave and Neolithic periods. Among the later additions may be noted a large series of implements, bones, etc., from the Grimes Graves flint mines, Moustier flints from Baker's Hole pit in the Thames valley, and implements of different ages presented by Dr. A. E. Peake and Rev. H. G. O. Kendall. The museum authorities have just purchased the entire series of local specimens, and the Palæolithic implements from the Dovercourt gravels collected by the late Lieut.-Col. Underwood, of Ipswich, and these make a very valuable addition to the collections. The skeleton of the Neolithic (or early Bronze age) youth found with an ornamented drinking vessel by Mr. Reid Moir at Wherstead, near Ipswich, is now on exhibition, together with other interesting human skulls, and the remains of extinct animals.

THE award of the Hanbury medal to Mr. E. M. Holmes, curator of the Pharmaceutical Society's Museum, for high excellence in the prosecution of original research in the natural history of drugs, is a fitting recognition of Mr. Holmes's unwearied activities in the domain of pharmaceutical and botanical science. In 1897 Mr. Holmes was the first recipient of the Flückiger medal, and his numerous contributions to pharmacography and botany up to that date are enumerated in the *Pharmaceutical Journal* of September 4, 1897. Since then he has contributed about two hundred articles and notes to the journal, and has also found time to continue his studies of the algæ, and of the British seaweeds in particular, of which group he is recognised as one of the first authorities. Among plants of pharmaceutical importance which have been the subject of Mr. Holmes's researches may be mentioned, in particular, jaborandi, Siam benzoin, strychnos, Natal aloes, cinchona, plants yielding myrrh, resins, etc. Plants yielding arrow poisons and plants which are the sources of poisonous drugs generally have been the subject of Mr. Holmes's careful and critical investigation, and pharmaceutical science is deeply indebted to him for the valuable work he has done in connection with medicinal plants and their products. It is largely owing to Mr. Holmes's wide botanical knowledge that his contributions to pharmacography rest on so sure and certain a foundation.

ON June 30 (June 17, old style) Dr. Alexander Fischer de Waldheim, director of the Imperial Botanic Garden of Peter the Great at Petrograd completed the fiftieth year of his scientific and administrative activities. The event was made the occasion of a fitting ceremony with presentation of addresses, etc., in the hall of the herbarium at the garden. Dr. Fischer de Waldheim commenced his botanical career as *privat-docent* at the University of Moscow, and later became professor of botany at the University of Warsaw. On the death of A. F. Batalin in 1897 he was appointed director of the gardens at Petrograd. It will be remembered that in 1913, on the 200th anniversary of the founding of the Petrograd garden by Peter the Great, the name of the institution was changed by rescript of the Emperor to that of the Imperial Botanic Garden of Peter the Great, and a representative scientific gathering took place at Petrograd on the occasion. Under the present director's able administration the garden has been greatly improved, and the scientific activities of the institution largely extended. With its museum, herbarium, and library, laboratory, seed-control station, and school of horticulture, the Imperial Botanic Garden forms a very complete institution, and its scientific publications are of the first importance.

ANNOUNCEMENT is made that the board of directors of British Dyes (Limited) is establishing a Research Department, and has invited Dr. G. T. Morgan, F.R.S., of the Royal College of Science for Ireland, Dublin, to become the head of the department. The board has resolved to appoint a Technical Committee, which will consist of Dr. M. O. Forster, F.R.S. (chairman), Dr. J. C. Cain, Dr. G. T. Morgan, F.R.S., and Mr. J. Turner. An Advisory Council, under the chairmanship of Prof. Meldola, F.R.S., is also to be appointed, and the following gentlemen have been invited to become members:—Prof. J. N. Collie, F.R.S., University College, London; Prof. A. W. Crossley, F.R.S., King's College, London; Prof. Percy F. Frankland, F.R.S., the University, Birmingham; Prof. A. G. Green, F.R.S., the University, Leeds; Prof. G. G. Henderson, Royal Technical College, Glasgow; Prof. J. T. Hewitt, F.R.S., East London College, London; Prof. F. S. Kipping, F.R.S., University College, Nottingham; Prof. A. Lapworth, F.R.S., the University, Manchester; Prof. A. G. Perkin, F.R.S., the University, Leeds; Prof. W. H. Perkin, F.R.S., the University, Oxford; Prof. W. J. Pope, F.R.S., the University, Cambridge; Prof. J. F. Thorpe, F.R.S., Royal College of Science, South Kensington; and Prof. W. P. Wynne, F.R.S., the University, Sheffield. The members of the Technical Committee will *ex officio* be members of the Advisory Council.

BRIGADIER-GENERAL T. E. WILCOX has published in the *Sunday Oregonian*, Portland, of May 9, an account of an expedition made in 1883, in which he took part, for the exploration of the Great Plateau of the Columbia, a region occupying approximately 22,000 square miles in the Washington State. It seems once to have formed the bed of Lake Lewis, whose waters were in early times held back by the mountain masses now broken through at the cascades of the Columbia. The original native population was swept away by smallpox introduced by the voyageurs of the Hudson Bay Company, and only a few remain, who live mostly by hunting and trapping.

THE *National Geographic Magazine* is dealing in succession with the areas involved in the great war. In the June number an interesting account by Mrs. F. C. Albrecht of the frontier cities of Italy is very timely. Much attention is naturally given to the architectural glories of Verona, with its Duomo and the statue of Madonna Verona looking down on the women haggling over their vegetables in the market-place. In a second article Karl Stieler describes Venice, and we can only express a hope that its buildings may be saved from Zeppelin attacks. The number contains eighty-seven superb photographs and two maps, and supplies an admirable account of a lovely country now involved in the perils of war.

THE *Indian Journal of Medical Research* for April (vol. ii., No. 4) contains several papers of considerable interest in tropical medicine and pathology. Major Christophers deals with the nature and significance of the spleen rate and other splenic indices, with a mathematical analysis of the data. A note of some importance by Major Greig deals with a case of infection of a reservoir of drinking-water in Calcutta through a cholera "carrier," *i.e.*, a native who, though well, harboured the cholera microbe. Owing to systematic bacteriological examination of the water, the infection was detected, and the source of it, the "carrier," was found and isolated.

THE National League for Physical Education and Improvement held a meeting at the Mansion House on Tuesday, July 6, to inaugurate a campaign to prevent the spread of epidemics by insects in war time. A series of six lectures upon the subject commenced on July 12. Lectures have also been given at the Child Welfare and Mothercraft Exhibition at the Passmore Edwards Settlement, and the importance of the fly as a disseminator of infantile disease has been emphasised at the exhibition. The Zoological Society's exhibition on the fly continues, and a lecture will be given at the society's office every Wednesday from July 14 on methods of controlling flies. The lectures are open to the public, and tickets can be obtained free on application to the society. Prof. H. Maxwell-Lefroy is responsible for the statement that flies are increasing rapidly, and in his lecture will deal with methods of control; the next three months will be important, and already the blow-fly has become an intolerable pest at the Front. Local exhibitions and lectures are being organised at Nottingham, Reading, Cardiff, and other places, and the public interest in this problem appears to be increasing.

THE *South African Journal of Science* for June contains an article by Mr. C. W. Mally, which shows the good results obtained with poisoned bait in controlling house-flies. The bait used is made up of one pound of sodium arsenite with ten pounds of sugar and ten gallons of water; experience proves this to be an extremely effective poison for the house-fly out of doors, and only a few applications are needed. The liquid is applied with a syringe to non-absorbent surfaces, to pieces of canvas, to manure heaps and rubbish tips. Bunches of twigs, of trees the leaves of which when plucked do not crinkle and drop off, are dipped in the solution and hung up where the flies congregate; the flies drink the poison and die literally in heaps. In military camps the method has been applied with success, and, in the absence of suitable trees, pieces of canvas have been sprayed and hung up, and the bait has been sprinkled near manure heaps and other places where flies gather; the bait is, of course, a human poison, but in military camps there is no risk in its use. The only alternatives, in Mr. Mally's opinion, are the accumulation of all manure in constructions from which flies cannot escape, or the treatment of all manure heaps with chemicals to prevent flies breeding. The first is expensive, though useful, because the enclosures can be so made as to let flies in but not out, the manure thus serving as a trap; the second is impracticable, because so little is known about it. In South Africa the use of arsenical baits for fruit flies has shown that an apparently reckless use of arsenic is not attended with risk to human beings; the poison bait method is therefore adopted where in England the fear of the consequences would

prevent its even being considered. Mr. Mally emphasises the cheapness, simplicity, and effectiveness of the method, and demonstrates its value in military camps especially.

THE Natural History Department of the British Museum has lately issued another (No. 12) of the handy little sets of "Instructions for Collectors," the subject of the pamphlet being "Worms," in a wide sense, the groups mentioned and illustrated ranging zoologically from the Cestoda to Balanoglossus. The localities where specimens of various classes and orders may be looked for, and the best way of collecting, killing, and preserving them are clearly explained. Especial attention is directed to the desirability of obtaining parasites, and the beginner is warned of the possibility of his meeting with worm-like parasites that are not worms—such as Pentastoma and various Crustacea. The "instructions" have been drawn up by Mr. H. A. Baylis; they will be useful to all museum officers who can set collectors at work in securing zoological specimens, whether at home or abroad.

WHEN the Zoological Society of Scotland was founded, for the purpose of establishing a zoological park, war-clouds had not even begun to form. When the storm burst on us the society had but just come into being. The council, then, is to be congratulated on being enabled to announce, in its second annual report, that all things considered its record is a very satisfactory one. Though naturally seriously hampered just now for lack of funds, progress is still being made in the housing of the animals. The results so far obtained in this direction in many cases surpass anything yet accomplished, either in London or Dublin. This success is due, in part, to natural advantages of environment, and in part to the possibility of improvement on the models of the older institutions. The admirable "acclimatisation house," for example, was modelled on the new small mammals' house of the London Zoological Gardens. From the beautiful photographs which appear in this report, it is plain that the gardens at Edinburgh have set a standard of housing that will be difficult to follow, at any rate from a spectacular point of view.

A VALUABLE contribution to the knowledge of the sperm whale (*Physeter macrocephalus*), based on the study of a fœtal specimen, is made by Dr. F. E. Beddard in the Annals of the Durban Museum, vol. i., part 2. Having regard to the high degree of specialisation which characterises the adult, it is not surprising to find that this specimen—which measured but 20 in. in length—presents many striking points of likeness to the pigmy sperm whale (*Kogia breviceps*), and the more generalised Delphinidæ. Such were particularly noticeable in regard to the head, which, in the first place, was strikingly small in comparison with the rest of the body, since it measured but one-quarter instead of one-third of the total length, which is the proportion in the adult. In old bulls, especially, the upper much overhangs the lower jaw; in this fœtus the snout did not project beyond the mandible, though the characteristic truncation was already complete. While in the adult but one nostril (the left) persists, in this specimen Dr. Beddard found unmistakable vestiges of the right also. In regard to the paddle, it is to be hoped that Dr. Beddard will soon publish a figure of the dissected limb, since in the adult the terminal phalanges enclosed within the apex of the limb are commonly wanting, from what cause remains to be discovered. Some important observations are also included in this memoir on the anatomy of the lungs and intestines, which raise some difficult morphological points not likely to be solved in the immediate future.

MR. E. D. MERRILL continues his descriptions of new or noteworthy Philippine plants in vol. x., No. 1, of the *Philippine Journal of Science*. Ninety new species belonging to thirteen natural families are described; the genera Aquilaria, Koompassia, Melilotus, Neptunia, Cymodocea, Diplanthera, Hanguana, Urceola, Vallaris, and Protium, are recorded for the first time from the archipelago.

IN an article in the *Indian Forester* for May an account is given of experiments made to test the power of germination of teak seeds when sown (1) after charring in a forest fire, (2) untreated, and (3) after being soaked in cow-dung fifteen days. The charred seeds collected from a burnt teak forest germinated profusely within a fortnight of sowing, and it is suggested that the best means of ensuring regeneration of teak is to prepare raised seed beds in burnt areas where teak is to be planted, and to sow charred seeds therein. Teak seedlings tend to die in large numbers if they have to be transported for long distances.

Kew Bulletin No. 4 is mainly occupied by an important paper on "Some Additional Species of Meconopsis," by the director, Sir David Prain, who is the authority on this interesting genus of Papaveraceæ which form so striking a feature of the flora of the Himalaya, Thibet, and Western China. This, the third monographic account of the genus by Sir David, has been necessitated owing to the introduction of several new species from China, and to the remarkable enthusiasm displayed by cultivators both in the formerly known Himalayan species and in those recently discovered by Messrs. Forrest, Ward, and Captain Bailey. In 1896 the number of known species was 23; in 1907 it had risen to 27, and now 40 species are recognised. In the paper a key has been drawn up for all the species, and the new species are described. Visitors to the Royal Botanic Gardens, Edinburgh, have been rewarded by seeing many of the species growing to perfection, especially those with brilliant blue flowers, and in the rock-garden at Kew there has also been a good display of several interesting species during the late spring.

IT has long been recognised that when an earthquake originates beneath the ocean and is accompanied by a large displacement of the ocean floor, waves on the surface of the sea necessarily result. Such a series of "tidal waves" (as they are generally but erroneously called) overwhelmed the north-east coast of Japan in 1896; and certain features as observed at Miyako suggested to Messrs. K. Sano and K. Hasegawa the investigation of the following

hydrodynamical problem: on the wave produced by the sudden depression of a small portion of the bottom of a sea of uniform depth. This they show to be nearly the same as a somewhat different problem in which a small part of the surface is subjected to a short-lived impulsive pressure. The numerical calculations are long and laborious, and a comparison of the results of the calculation with what was observed at Miyako lead to the following conclusions:—(1) There is good agreement between the calculated and observed time intervals from the beginning of the earthquake to the arrival at Miyako of the first wave crest; (2) there is a fair agreement between the calculated and observed time intervals from the beginning of the earthquake to the arrival of the second wave crest; (3) calculation and observation agree in assigning the greatest crest to the second wave. The paper is published in the Bulletin of the Central Meteorological Observatory of Japan, vol. ii., No. 3, 1915.

REMAINS of the gigantic horned dinosaurs from the Upper Cretaceous formations of Alberta, western Canada, have been collected so assiduously during the last few years, both by Canadians and Americans, that it is now possible to realise how numerous and varied were these strange land-reptiles. While describing a new genus, Eoceratops, which he thinks may be ancestral to many of the others, Mr. Laurence M. Lambe has just published a tabular synopsis of the group, defining the various forms that seem to be distinguishable (Canada, Geological Survey, Museum Bulletin, No. 12, Geological Series, No. 24). Sometimes the great bony frill over the neck is continuous, sometimes it is pierced with vacuities; while the shape and size of the bony bosses round its rim are remarkably varied. There seems to have been a tendency in the horned dinosaurs to produce a separate bony boss on each prominence of the upper part of the skull, and scarcely any two specimens are alike. The nasal horn-core proves to be especially complex, being formed of the tips of the two nasal bones fused with a pair of superposed bony bosses. In one of the newly discovered skulls this nasal horn-core is in the shape of a forwardly turned hook. Mr. Lambe's paper is illustrated by numerous drawings of important specimens in the Canadian Geological Survey collection at the Victoria Memorial Museum, Ottawa.

THE Department of Revenue and Agriculture of the Government of India has issued a memorandum on the meteorological conditions prevailing in the Indian monsoon region before the advance of the south-west monsoon of 1915, with an estimate of the probable distribution of the monsoon rainfall in 1915. The memorandum has been drawn up by Dr. G. C. Simpson. A clear statement is given of each factor supposed to have a controlling influence on the conditions. High pressure over South America during the period March to May is found to be favourable to the monsoon; the conditions under this head are said to be distinctly unfavourable. Low pressure in Australia, Indian Ocean, and Africa in May is favourable to monsoon rainfall in India, while a deficiency in rainfall at Zanzibar and in the adjacent parts of East Africa also has a good effect; the conditions in this region are said not to be sufficiently pronounced to exert any marked influence. The effect of an excess of snowfall accumulation upon the monsoon rainfall of India as a whole is to diminish it in the early portion of the season; while no effect on the rainfall of August and September can be detected; it is estimated that the snowfall is not likely to exert a prejudicial effect on the monsoon, but the prolongation of the winter conditions may indicate the late arrival of the monsoon and unsteadiness during the first part of the season. The conclusion arrived at is that while the monsoon of 1915 may not be so good as that of 1914, there are no indications of a serious deficiency in the total rainfall. The Arabian Sea current is likely to be less active than the Bay current.

IN a paper on the temperature coefficient of magnetic permeability of irons within the working range, which appeared recently in the Journal of the Bureau of Standards, Mr. R. L. Stanford directed attention to the necessity of either working at a standard temperature, or determining the temperature coefficient of the actual material under test if results accurate to within 1 per cent. are to be obtained. On testing a number of rings of cast-iron, wrought-iron, and low carbon steels of about 10 cm. diameter and radial depth 0·5 to 1 cm. at temperatures between 3° C. and 88° C., he found that before consistent results could be obtained it was necessary artificially to "age" the specimens by heating and cooling them a number of times. This process generally necessitated the use of about 15 per cent. more magnetising force to produce the same induction—2000 to 16,000—in the aged specimen. For such specimens he finds that the temperature coefficient of permeability may be as high as 0·3 per cent. per degree, and that a neglect of the temperature effect may in a rise of 10° C. to 20° C. produce an error of 2 per cent. or more.

IN a paper published in the *Journal of Physiology* for May 12, on the simple character of the yellow sensation, Dr. F. W. Edridge-Green brings forward, in a collected form, various arguments which have been urged in favour of this sensation being simple in contradistinction to the theory of Young-Helmholtz, which asserts that it is a sensation compounded of simple red and green. The chief support of the latter statement is the fact that a spectral yellow can be exactly matched by a superposition of red and green. Dr. Edridge-Green urges, however, that "it is wrong to assume that the physiological sensations are similarly constituted." In many of the experiments that have been made by other observers coloured papers have been employed instead of spectral colours. Even the most superficial experimentalist will now admit that this practice robs the results of definite scientific meaning. Dr. Edridge-Green has studiously kept to spectral colours, and his results deserve close attention. Amongst many other results he adduces the following:—(1) If the eye be fatigued with pure yellow spectral light the spectrum will appear to have lost its yellow, but the terminal red of the spectrum will not be affected. (2) If the eye be fatigued with red light even by looking through a red glass held against a light for one second, the red in the spectrum will not

be visible for some considerable time, but the eye may be fatigued for twenty minutes with yellow light without interfering with the visibility of the red light. (3) The eye may be fatigued with red or green without altering the hue of spectral yellow. This may be shown by wearing red or green glass spectacles which are transparent to yellow. (4) When a sodium flame is viewed after fatigue with spectral red light it is very little affected in the region of the after-image, though the green-blue after-image is very strongly marked on either side of the sodium flame, when the after-image is larger than the flame. The fundamental phenomena of colour sensation are still very obscure. Perhaps the most difficult fact to explain away is the obvious simplicity of *white*, if it be indeed true that it is compounded of many tints.

BULLETIN No. 1 of the Chemical Section of the Wellcome Tropical Research Laboratories, Khartoum, contains a paper on the estimation of methyl alcohol in the presence of ethyl alcohol, by Mr. W. A. R. Wilks; in this paper the standard process of Thorpe and Holmes is slightly modified so as to increase the degree of accuracy. Bulletin No. 2 is a discussion of the applicability of papyrus to paper manufacture by Dr. W. Beam; it is concluded that after allowing for the collection and transport of the papyrus to Europe, there is a margin for profit for this substance as a raw material in the paper industry. Bulletin No. 3, by Dr. Beam, deals with tests for hashish, more particularly the test which depends upon the fact that the resinous matter, "cannabinol," of hashish produces a rich purple colour on treatment with a small amount of caustic alkali. The principal point to which attention is directed is that the extract of *Cannabis indica* does not usually respond to this test; the influence of soil, climate, method of cultivation, and curing seems to have much greater effect on the chemical composition of this plant than has hitherto been suspected.

PROF. F. C. LEA and Mr. W. Norman Thomas have an article in *Engineering* for July 2 on the change in density of mild steel strained by compression beyond the yield point. Experiments were undertaken with a view of ascertaining how far changes of density occur in overstrained mild steel, and whether any change in density occurs with time after the straining-load is released. Preliminary experiments definitely indicated that a change of density was brought about by over-straining, and that the time factor was important. Until this was recognised it was difficult to get consistent results. For results to be comparable two conditions must be observed. First, if the specimens are loaded considerably beyond the yield point, the final loads must be kept on the specimens for the same time; in other words, the amount of strain, and thus the change in density, are dependent upon the time of loading. Secondly, the densities should be determined as soon after the loading as possible. Results show that an increase in density occurred during a rest period of from thirty-five to thirty-eight days after the load had been removed. Experiments are suspended meanwhile as Birmingham University is in use as a hospital.

WE have received from Messrs. Charles Baker a catalogue of microscopes and accessories, all of which are manufactured at their factory in London. The list includes several new models, amongst which are three instruments similar to the Continental designs, the prices of which compare very favourably with those quoted abroad. Another instrument of interest is "the workshop metallurgical microscope." The catalogue is well produced and copiously illustrated.

OUR ASTRONOMICAL COLUMN.

THE STRUCTURE OF THE UNIVERSE.—If the distance of each star were known in addition to its position in the sky, our knowledge of the present structure of the universe would be complete. In order to determine the change in the structure, it would be only necessary to know the motions of the stars. We know the positions of a great number of the stars and their motions across the line of sight; we know also the velocities in the line of sight of a few, and the distances of a still smaller number. The data for the solution of the problem are therefore very meagre. Nevertheless, there are indirect methods of attacking the problem which may tend to lead one to an approximate solution, and it is these methods which form the subject of the very instructive article which appears in the July number of *Science Progress* by Mr. H. Spencer Jones, of the Royal Observatory, Greenwich. The idea, as he states, that the centre of our system is occupied by an immense sun, many thousands of times larger and more glorious than our own sun, and that round about it are millions of lesser suns of various sizes, together forming the nucleus of an immense spiral nebula, of which the spiral arms coiling around the nucleus appear to us as the Milky Way, and that this to us immense system is but one, and perhaps a comparatively small, island universe amongst thousands or millions of other island universes in space, is an idea which by its magnificence appeals to the mind of man. What forms the substance of the article is the basis of truth upon which this conception is founded, and the straightforward and clear way in which the author has marshalled his evidence makes the article of particular interest.

THE NEBULOUS REGION NEAR OMICRON PERSEI.—It is due to photography and the portrait lens that our knowledge of the large diffused nebulæ and the dark regions of the sky has been gained, and it was only recently that Prof. E. E. Barnard's work in this field was referred to in this journal. Attention is now directed by him to the great nebulous region near Omicron Persei (*Astrophysical Journal*, May), a photograph of which he describes and illustrates. The photograph was specially taken to examine more closely this region for dark or partly luminous matter which produces the apparent vacancies. The attempt was successful after giving an exposure of 6 hours and 41 minutes with the Bruce 10- and 6-in. telescopes. Prof. Barnard describes the photograph in some detail, and points out the association of this region with that of the Pleiades, of which it forms part.

WORK AT THE LOWELL OBSERVATORY.—Among the many interesting contributions to the *American Museum Journal* (vol. xv., No. 5), two deal with the fine photographic work which is being carried on at the Lowell Observatory, this observatory being situated in Arizona at an elevation of 7250 ft., the finest site of any existing similar institution. The articles in question are on the subjects, "Oxygen and Water on Mars" and "The Photograph in Astronomy," and are

written by the director of the observatory, Prof. Percival Lowell and Mr. E. C. Slipher respectively. The illustrations are a distinguishing feature of both communications; they show the great 24-in. refracting telescope and the dome in which it is housed; comparison spectra of the moon and Mars demonstrate the difference in darkness of the water-vapour band indicating the presence of water vapour in the atmosphere of Mars. Photographs of the planets Saturn and Jupiter give one an idea of the great advances made in recording their surface features and satellite phenomena, while the spectrum of the latter planet affords a means of measuring the speed of rotation by noting the slant of the lines. Photographs of nebulæ and comet 1910*a* are included among other illustrations.

THE MUSEUMS ASSOCIATION.

TO associations as to individuals there comes a time of trial, when their worth to the world is tested. The Museums Association, like other bodies, had to be proved by this year of war, and if it hesitated fully to grasp the great occasion, yet it rose not ignobly towards it. Devoted to the arts and studies of peace, it would fain have withdrawn awhile from the turbulence, had not a fortunate rule insisted on at least a general business meeting. Still wishing to be inconspicuous, it chose London as its place of assembly on July 7–8, proposing to do little more than prolong the official life of its officers and council who, it was thought, had been robbed of their opportunities by the war. Happily for the association, some wider imaginations took a stronger line, and determined to show that the association and its constituent museums could now serve the nation better than ever. Happily, too, the hospitality of the Victoria and Albert Museum, gracefully offered by the Board of Education through Sir Cecil Smith, dragged the conference from its self-sought obscurity.

At the outset the dominant note was struck by Dr. Bather (Natural History Museum), Mr. Butterfield (Hastings), and Mr. G. W. Prothero (Central Committee for National Patriotic Organisations). Both now and for a long future the situation is changed, and museums, they said, must meet it. Working by their special methods, they can stimulate enthusiasm, ward off discouragement, teach people how to help the forces at sea and in the field, how to fight disease and its causes, how to economise with profit to the nation as well as to themselves, how to supplement our food-supply; and, looking further ahead, they can indicate within the Empire sources of supply for our industries, can furnish manufacturers with foreign models, and, above all, can help in the physical and mental upbringing of the coming generation, to whom they must hand on undimmed the lamp of peaceful learning.

The sort of exhibits by which this important work might be accomplished are sketched in an editorial already published in the *Museums Journal* for July. Many of them were dealt with in more detail by speakers in the discussion (especially Messrs. Howarth, of Sheffield, Bolton, of Bristol, Woolnough, of Ipswich, Deas, of Sunderland, and Williamson, of Derby), or formed the subject of separate papers. Thus Dr. Grant Ogilvie (Science Museum) showed how the conditions of life and the earning powers of the community might be improved by a carefully thought-out scheme of exhibits linking up the fundamental principles of science and the elementary materials of art with the industries of each locality; the visitor is more interested in things connected with his daily activities, and the museum sends him back with more intelligent interest in those activities. On the true scientific foundation must be based appropriateness of design, carried out by sound workmanship; and so Mr. H. H. Peach, of the Leicester Art School, expounded the objects of the newly-formed Design and Industries Association, and indicated the help that the museum might best give in its attempt to organise the artistic faculty in union with the technical ability and commercial enterprise of the nation.

As regards industries, museums have also their own interests to serve; glass jars and other apparatus, metal trays and cases, formalin and various reagents, are among the museum material hitherto obtained chiefly from Germany, owing to the inability or unwillingness of British manufacturers to meet the demands of curators. A committee was appointed to approach manufacturers with a statement of probable requirements and to invite tenders. We trust that this committee will consult with those committees of the British Science Guild which are doing similar work (NATURE, July 8, p. 520).

But dearth of men will be a greater danger than dearth of material, and, as was forcibly pleaded by Nurse Prior, museums might well follow the example of Leicester, and devote a section to children's welfare, showing by concrete examples the right and the wrong ways of nursing, feeding, and clothing babies.

And then these children will have to be educated, a task in which the museum will take no small share. Of all peaceful activities the education of the young is the one that most needs to be kept going, and day by day we realise afresh that the thing seen is more forcible than the thing heard.

It was thus most fitting that the conference should conclude with a discussion between museum curators and representatives of the Education Section of the British Association. The case of the educationists was presented in a profound yet lucid address by Prof. Green, of Sheffield, who urged the claims of the children and other uninstructed visitors. For them are not wanted the analysis and system of the specialist, but a free synthetic treatment that shall bring each object into relation with the outer world, and particularly that world which is known to the child. The difficulty raised by Mr. Madeley, that each visitor brings a different world of his own, shows that labels are insufficient to give the synthesis needed for each case. We must have recourse to the human interpreter, and the question is—in what form? The best interpreter ought to be the trained teacher already familiar with the child's mind and world; but, unfortunately, the elementary-school teacher must himself be taught how to use a museum. Two means of effecting this were suggested: Prof. Green would present the teachers with a printed guide, showing them how to utilise the exhibits. Mr. Spurley Hey, director of education for Manchester, had selected the most suitable teachers and handed them over to the directors of museums to be trained as they thought best for the purpose of taking pupils round. This might partly meet the financial difficulties, which were emphasised by Messrs. Bolton and Woolnough. Modes of co-operation between museums and teaching institutions of higher rank were suggested by Dr. Bather, and other solid contributions to the discussion were being made by speakers of varied experience, when the meeting was brought to an abrupt conclusion.

During its first quarter of a century this association has, we gather, proved of service to its members; if now they will act up to the ideals set before them at this twenty-sixth annual meeting, it should prove of no less service to the nation.

THE DAYLIGHT FIREBALL OF JULY 5.

VERY large meteors apparently exhibit a preference for the early evening hours. The fireball of March 28 last came at 7.48 p.m., and a great number of corroborative instances might be cited. The majority of these bodies travel with comparatively slow motion over extensive arcs, and are directed from radiant points in the western region of the heavens.

On Monday evening, July 5, at 8h. 30m., a few minutes after sunset, a splendid fireball passed from west to east in a long and nearly horizontal flight across the southern sky. The weather was generally clear over the south of England at the time, and thousands of observers were fortunate in catching a sight of the meteor as its nucleus disintegrated into a series of glistening balls strung on a fiery cord.

The spectacle was viewed by persons who sent in reports from Gloucestershire, Dorset, Hants, Essex, Somerset and Surrey, but the descriptions are rather indefinite owing to the conditions prevailing at the time. No stars were visible to which the path of the object might be referred. Yet, though daylight was so strong, the meteor brightly illumined the sky and attracted people to look upwards to ascertain the cause.

Mr. W. G. Wallace, of Broadstone, Dorset, writes that his sister saw the meteor in a S.S.E. direction, altitude about 30°. It disappeared over E. by S., altitude 20°. The object presented a brilliant mass of greenish-yellow light, moving slowly, and near the end of its flight it divided into two portions.

Mr. A. G. Pile, of Old Sodbury, Gloucestershire, observed the meteor moving from S.W. towards E. in from four to five seconds. It emitted a bluish-yellow flame, and looked like a large sky-rocket.

Mr. Dick, of Purley, Surrey, states that it quite lit up the sky, and travelled from S.W. to E. by S., about 20° high. It split into two large fragments early in its flight. What specially struck him was the horizontal course, duration about 13 seconds.

Mr. W. J. Allen, of Thornbury, Glos., saw the bright light of the meteor traversing the sky in a horizontal direction from S.W. to E. When first noticed it apparently consisted of three electric balls, but at the end only two could be discerned.

Mrs. L. E. Butter, of Bishops Waltham, Hants, reports that her son, when sitting in the garden, called her to see a bright, comet-like appearance travelling from S.W. to eastward. There was a secondary head merging into the tail. The object finally burst like a rocket.

Mrs. H. I. W. May, of Chadwell Heath, Essex, relates that her daughters saw a brilliant star in the south going from west to east. While watching it the head divided into three stars and then disappeared.

At Bristol the meteor passed from W. of S. to E.S.E.; the angle of descent was slight, motion rather slow, and the nucleus consisted of two balls of fire, the leader being the largest. There was a profuse emission of sparks as the object sailed along, and the duration for the section of the flight which came under observation was six seconds.

Mr. E. W. Barlow writes that at Bournemouth the phenomenon was remarked by various people who could not, however, give exact particulars of the event. When passing due S. the altitude was 40° to 45°, and the motion horizontal. The direction was from west to east.

I have been in correspondence with the various observers and elicited much further information, which has enabled me to derive the real path of the meteor. But the result may possibly require revision on the basis of additional records:—

Fireball of July 5, 8h. 30m.

Radiant point	152°-6°
Height at beginning	57 miles
Height at end	28 „
Length of luminous path	260 „
Velocity per second	20 „
Position over English Channel from...	S. of Plymouth
„ „ „ to ...	Boulogne, France
Number of descriptions	12

The radiant was near the W. by S. horizon, and its position must have been deflected several degrees towards the N.E. by the effect of zenithal attraction.

There is a special reason why so many fine meteors overtake the earth in nearly horizontal courses, and appear in the earlier hours of the night.

W. F. DENNING.

THE MATERIAL BASIS OF EVOLUTION.

THE "Origin of Single Characters as Observed in Fossil and Living Animals" forms the subject of an illuminating essay in the *American Naturalist* for April, by Prof. H. F. Osborn. Since it contains some trenchant criticisms on recent attacks on the evolution theory, and on Darwin's work, it is likely to be much discussed in the immediate future.

The main purpose of his address is to insist on the importance of single characters, or "least characters," as indices of the trend of evolution rather than on the sum of the indefinite number of single characters which make up the individual. "In a sense," he remarks, "the species, subspecies, and variety, and even the individual, is not a zoological unit, whereas the 'character,' when narrowed down to the last point of divisibility, seems to be a unit . . . and a very stable one, with certain distinctive powers, properties, and qualities of its own." This conception of the individual as a complex of separable and independently variable units represents a view which has been gaining ground for some time past.

But Prof. Osborn attempts to systematise this newer conception of the factors to be reckoned with in studying the elusive and complex phenomena associated with the transformation of animals. He distinguishes two aspects of this process—the study of the birth and development of proportional, and of numerical characters. Those of the first category he defines as universal and abundant; they are such as distinguish species and subspecies one from another, and may be germinal and therefore heritable, or merely somatic, due to environmental influences; while numerical characters, on the other hand, are solely germinal.

As numerical characters he cites the number of the teeth and of their cusps, the number of toes and of vertebræ, and so on, such being relatively stable characters which may be shared in common between a large number of species and genera.

That no hard and fast line can be drawn between "proportional" and "numerical" characters Prof. Osborn himself realises, for he uses as an illustration the reduction of the digits, as in the case of the evolution of the horse's foot. Hence it seems difficult to accept his dictum that proportional and numerical characters are due to a different series of direct causes. Rather they seem to be merely measures of degree—quantitative and qualitative.

Towards the latter part of his essay he aims a blow at the Mendelians, and remarks that "If the student of genetics abandons the natural and the normal for the unnatural and the abnormal and sticks solely to his seed pan and his incubator, he is in danger of observing modes of origin and behaviour of characters which never have, and never will, occur in

nature." Nor is he less positive that there is no evidence whatsoever in support of the theory that "species" may arise from fortuitous, saltatory characters. This is one of the traditions, he tells us, of the master mind of Darwin that we must abandon entirely. But this, surely, is yet at least a debatable point. Prof. Osborn apparently is convinced that all characters must run the gauntlet of selection. To attempt to defend such a position is to court disaster.

As Prof. Osborn himself maintains, the individual is to be regarded as a complex of unstable units, and this instability is expressed in a tendency to development along new lines of growth. Each unit, in short, has its own individuality and potentialities of development, which are controlled, in the first instance, by the immediate environment—the neighbouring units of the organism—just as the organism as a whole is in turn controlled by the external environment, or by "selection." Where the incidence of the struggle for existence falls lightly, such units may give rise to hypertrophied outgrowths, as, for example, in the train of the peacock, or in the huge wings of the Argus pheasant: where the struggle for existence is severe, ornament and other exuberances of development are suppressed.

Finally, in regard to natural selection and its relation to the origin of characters, Prof. Osborn remarks that we know nothing; hence he seems disposed to regard with something like approval the recent enunciation of Prof. Bateson that we may have to forgo the theory of the addition of germinal factors, or determinants, and substitute the theory of variation by loss of factors.

This theory of evolution by "loss" seems to have captivated many, but surely when the phenomena on which this is based are carefully examined it will be found that the phrase "evolution by loss" amounts to no more than an emphasis of the fact that the evolution of new types is but a more striking phase of the evolution of species. For with types, as with the species which they embrace, the material basis of evolution is afforded by Prof. Osborn's "allometrons" or "proportional characters."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

EDINBURGH.—At the summer graduation on July 8 Sir William Turner, the Vice-Chancellor, who presided, said the University roll of honour now contains more than 4000 names. Among the honorary degrees conferred were the following:—*Doctor of Laws*: Sir Robert Blair, education officer, London County Council; Prof. W. A. Herdman, University of Liverpool; and Prof. Arthur Thomson, University of Oxford.

THE Department of Agriculture and Technical Instruction for Ireland has issued as a pamphlet a descriptive account of the Irish Training School of Domestic Economy. The school is situated at St. Kevin's Park, Kilmacud, Stillorgan, Co. Dublin. The premises stand in grounds of about three acres, in one of the finest situations in South County Dublin. The house provides ample accommodation for the staff and students, in addition to class and recreation rooms. The school is a residential institution, maintained by the Department of Agriculture and Technical Instruction for Ireland, for the purpose of training teachers of domestic economy, and also for providing a training in household management for girls who have received a satisfactory education. The work of the school comprises two courses of instruction—a course of instruction extending over one year in household management, the object of which is to train girls for the management of their own homes, and a further two years' course of training for teachers of domestic economy.

WE have received a copy of the report of the council to the members of the City and Guilds of London Institute for the year 1914. The results in the department of technology show that the year 1913–14 was a record year, so far as regards attendance at classes in technology. During the session 5049 classes in technological subjects were registered by the institute in 321 towns, and these classes were attended by 55,996 students, showing an increase of 1486 on the numbers in the previous year. At the examinations, 23,119 candidates were presented in technology, showing an increase of 1241, and by including candidates from India, from the overseas Dominions, and from other parts of the Empire, and for special subjects other than technology, the total number of examinees was 26,776. But the effect of the war has been felt severely in this as in other departments of the institute's work. Four appendices contain detailed reports of the dean on the City and Guilds (Engineering) College, of the principal on the City and Guilds Technical College, Finsbury, on the City and Guilds South London Technical Art School, and on the work of the department of technology, in each case for the session 1913–14.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, June 25.—Dr. A. Russell, vice-president, in the chair.—Sir J. J. **Thomson**: Conduction of electricity through metals. The discovery by Kamerlingh Onnes, that at the temperature of liquid helium some metals can exist in a state in which their specific resistance is less than one hundred thousand millionth part of that at 0° C., appears to necessitate the abandonment of the ordinary theory of metallic conduction, as the experimental conditions prohibit the explanation of the phenomenon by an abnormal increase, either in the number or mean free path of the free electrons. The effects observed by Kamerlingh Onnes may, however, be accounted for by a theory of metallic conduction previously given by the author in "The Corpuscular Theory of Matter." On this theory the atoms of some substances contain electrical doublets—*i.e.* pairs of equal and opposite electrical charges at a small distance apart. The effect of an applied E.M.F. is to alter the heterogeneous distribution of the axes of these doublets by bringing them into partial alignment with the field. The function of the applied field is to produce the alignment of the doublets; the actual transference of electricity is effected by the large interatomic forces brought into being by the polarisation of the doublets. Thus, if the polarisation remains on withdrawing the applied E.M.F. the current will also remain.—Lieut.-Col. G. O. **Squier**: An unbroken alternating current for cable telegraphy. (1) The paper proposes a new angle of view in the method of transmission of signals in the submarine telegraph cable, and describes some apparatus for operating on the general principles involved. (2) An ocean cable is considered as a power line, and starting with the standard form of circuit which would be used in case it were required to operate an electric motor through an ocean cable, experiments are described to determine the minimum possible variations required in such a circuit to permit the alternating current received to be interpreted in dots, dashes, and spaces of the present alphabet. The uninterrupted alternating current used in transmission is operated on synchronously by the ordinary transmitting tape, so as to alter the im-

pedance of the transmitting circuit at the instants when the current is naturally zero. Dots, dashes, and spaces are each sent by semi-waves of either sign, but of different amplitudes. The alternating current received may be read directly from the record made by a siphon recorder, or this current may be employed to operate a siphon Morse printer, by means of an adaptation of Muirhead's gold-wire relay, or a Heurtley magnifier and a local wire relay. (3) The voltage stress along an Atlantic cable when an alternator is employed is shown, and the transmitting impedance of such a cable is computed as the frequency varies. (4) A special form of cable dynamo to operate at frequencies from 4 to 10 was used in the experiments described. (5) The fundamental principle is developed of never metallically "breaking" the transmitter circuit, which permits of greater accuracy in balancing the duplex bridge.

EDINBURGH.

Royal Society, June 21.—Prof. Hudson Beare, vice-president, in the chair.—Dr. A. **Lauder** and T. W. **Fagan**: The composition of milk as affected by increase in the amount of calcium phosphate in the rations of cows. In these experiments the amount of calcium phosphate added was gradually increased to 8 oz. per head per day. No increase in the amount of phosphorus or of mineral matter in the milk could be detected, in agreement with the generally received opinion that within wide limits the composition of milk was little affected by the nature of the food fed to the cow.—J. Herbert **Paul**: A comparative study of the reflexes of autotomy. Self-amputation of limbs in the Decapod Crustacea is accomplished in various ways. Thus hermit crabs when removed from their shells usually respond to injury by plucking off the damaged limb with their claws. The "true" crabs possess a specialised mechanism by which the limb is weakened at the breaking plane, so that a very slight force can sever it. In lobsters, a special muscle, by violent contraction, weakens the limb along a groove in the third segment, and immediately the imprisoned limb is left in the grasp of the enemy. If the more highly developed mechanism is disorganised in certain species, the animal returns, as it were, to the ways of its ancestors, and attempts to amputate the injured limb by more primitive methods.—Dr. M. **Young**: A contribution to the study of the Scottish skull. The investigation was based upon a study of more than 700 skulls which have been for some years in the possession of the anatomical department of the University of Glasgow. The greater number were collected by W. K. Hutton, lecturer in anatomy, Queen Margaret College, and were obtained during the excavation of an old Glasgow burying ground. The skulls are in the great majority of cases West Scottish skulls. They are more dolichocephalic than the average of Sir William Turner's series of Scottish skulls, but resemble most closely those in this series which are derived from Renfrewshire. Comparison between the two series has been made by the ordinary method; and the Glasgow collection has also been examined by modern biometrical methods, and the variability, as well as the correlation of the West Scottish skull as regards many of its dimensions and characters, have been determined and compared with those found in other series of skulls. One hundred specimens in the collection were divided in the medial sagittal plane, and from a study of the sectorial diagrams it appears that certain values of features which have been regarded hitherto as of morphological importance in different races fall within the range of variation shown by the large homogeneous West Scottish series. The skulls are similar in type to the "Long Barrow" crania from the chambered caverns of Arran, described by Prof. Bryce, and the Whitechapel English series of crania described by Dr. Macdonnell. They are without doubt those of the descendants of the Iberian or Mediterranean stock or race who have remained in the West of Scotland and have been less influenced by the later brachycephalic type than has been the case in the east of Scotland. Their mean values represent only a type of Scottish skull, but this type perpetuated in comparative purity in the present collection is that which, modified by various factors, has resulted in the diverse cranial form seen in Scotland at the present day.—Dr. **Ashworth** and Dr. J. **Ritchie**: The morphology and development of the free-swimming sporosacs of the hydroid genus Dicoryne; with description of a new species. The sporosacs of *D. parthenopeia* closely resemble those of *D. conferta*, except that they have a single tentacle, and the female sporosac bears only one ovum. The oocytes are differentiated and grow in the ectoderm of a blastostyle in the position which the sporosac will ultimately occupy; there is no migration of oocytes. The sporosac does not exhibit during development any trace of medusoid structure; there is no evidence that this sporosac has undergone regression from the condition of a medusa or medusoid gonophore. The general structure of the colony of *D. parthenopeia*, the regenerative capacity of the stolon, the method of release of the sporosacs, and the early development of the egg are also described.

PARIS.

Academy of Sciences, July 5.—M. Ed. Perrier in the chair.—M. **Giller**: Lightning and telegraph lines. An analysis of certain features common to all telegraph posts struck by lightning, and a suggestion for avoiding damage by the introduction of a spiral resistance possessing self-induction.—Henri **Pénau**: Cytology of the *Bacillus verdunensis*. This new species has been found in water at Verdun, and has some properties in common with the *coli* bacillus, from which, however, it can be separated. Details of various stages of growth are given.—M. **Gard**: A genus of Papilonaceæ, new for cyanogenesis.—Ed. **Crauzel**: The treatment of recent wounds by an expansible solution of iodine. The use of ether containing 5 per cent. of iodine in solution is suggested as offering advantages over the usual alcoholic tincture. It does not change in strength, and penetrates rapidly into wounds.—J. **Cluzet**: A simple method for the electrical examination of paralytics. The apparatus consists of a system of condensers, capacity from 0·01 to 12 microfarads, capable of utilising directly current from lighting mains. The use of the instrument in diagnosis is described.—A. **Policard** and A. **Phélip**: The first stages of the evolution of lesions in wounds caused by war projectiles, with some practical consequences. All fragments of clothing must be removed from the wound at the earliest possible moment. Too free use of antiseptics may diminish the defensive reaction of the tissues in the neighbourhood of the wound.—M. **Billon-Daguerre**: A mode of producing thin sheets of liquids for sterilisation by ultra-violet light.

WASHINGTON, D.C.

National Academy of Sciences, presented to the Academy from April 15 to May 22.—C. G. **Abbot**, F. E. **Fowle**, and L. B. **Aldrich**: Confirmatory experiments on the value of the solar-constant of radiation. Observations at Mt. Wilson from sunrise until ten o'clock, and records obtained by a recording pyrheliometer attached to sounding balloons rising to the altitude of 24 km. confirm the value of 1·93 calories per square centimetre per minute previously obtained for the radiant energy received by the earth from the sun.—T. H. **Goodspeed** and R. E. **Clausen**: Varia-

tion of flower-size in Nicotiana. During five years of study of the inheritance of flower-size in Nicotiana it has been found that the flower-size is not so constant as it has been assumed to be, but is affected by a number of conditions, some of which may not affect the length and the spread of the flower in the same manner.—I. S. **Kleiner** and S. J. **Meltzer**: Retention in the circulation of dextrose in normal and depancreatised animals, and the effect of an intravenous injection of an emulsion of pancreas upon this retention. In normal animals the circulation possesses the ability to get rid readily of a surplus of dextrose injected intravenously. This ability is impaired in the absence of the pancreas, but can be temporarily restored by intravenous injections of pancreas emulsion. Such injections, moreover, are capable of reducing the hyperglæmia due only to depancreatisation.—T. H. **Goodspeed**: Parthenocarpy and parthenogenesis in Nicotiana. Mrs. R. H. Thomas found frequent cases of parthenogenesis in Nicotiana; but other experimenters have been unable to verify these results. The present investigation, conducted upon the particular strains of tobacco of which seeds were furnished by Mrs. Thomas, shows that in those strains parthenocarpy is a frequent occurrence, and that parthenogenesis is also peculiar to this variety.—R. H. **Lowie**: Exogamy and the classificatory system of relationship. The exogamous factor must have been a real cause in moulding the kinship terminology of at least some so-called classificatory system. This conclusion is reached by a study of the character of two Siouan tribes, the Crow and Hidatsa.—F. R. **Moulton**: Solution of an infinite system of differential equations of the analytic type. If the number of mutually gravitating bodies in the universe is infinite, and if beyond a finite number of them their initial distances from one another increase with sufficient rapidity as the number of bodies increases, there is a rigorous, though limited, solution of the problem of infinitely many bodies.—L. J. **Cole** and N. F. **Kirkpatrick**: A seven years' study of inheritance in pigeons leads to the conclusion that the normal ratio of the sexes of pigeons hatched is 105 males to 100 females; that the number of unisexual broods exceeds the number of bisexual broods; that there is no tendency for first-laid eggs to hatch males and second-laid eggs to hatch females; that there is a correlation between the time of hatching the second egg and that of laying the first; that the birds continue to sit beyond the normal period of incubation if the eggs do not hatch.—Alice **Rohde**: Vividiffusion experiments on the ammonia of the circulating blood. The generation of ammonia in shed blood occurs in the non-diffusible constituents of the blood.—C. P. **Olivier**: 126 parabolic orbits of meteor streams. Although the most important feature of this investigation is the calculation of 126 parabolic orbits, the most interesting result is the final proof of the connection of the Halley's and η-Aquarid meteors. It is further concluded that radiants are not stationary.—C. **Schuchert**: The basal silurian formations of eastern North America. Medina, Cataract, and Brassfield are to be retained as names for independent marine faunas and formations.—B. M. **Davis**: A method of obtaining complete germination of seeds in Oenothera and of recording the residue of sterile seed-like structures. By sowing seeds upon pads of filter papers placed in Petri dishes and thoroughly soaked, and by keeping the culture at constant temperatures, rapid germination was obtained.—S. J. **Bates**: The osmotic pressure of the ions and of the undissociated molecules of salts in aqueous solution. The author shows how the partial osmotic pressures of the ions and of the unionised molecules can be calculated by thermodynamic principles from the freezing-points and conductance-ratios at a series of concentrations. The results show that in general the osmotic pressure of univalent ions is considerably smaller, and that that of the undissociated molecules is very much larger, than would be required by the osmotic-pressure law of perfect solutions.—T. **Lyman**: The extension of the spectrum beyond the Schumann region. The author has been able to reach the wave-length $\lambda 600$, and finds seven or eight lines in the helium spectra between $\lambda 900$ and $\lambda 600$, some of the lines being fairly strong.—A. S. **King**: Unsymmetrical lines in tube-arc and spark spectra as an evidence of a displacing action in these sources. The observed effects seem to be harmonised by considering as a necessary condition the presence of electrified particles moving at high velocities, these being produced in the arc and spark by the strong potential-gradients, and in the tube-arc by the large consumption of energy.—H. **Blumberg**: The factorisation of various types of expressions. The methods of E. H. Moore's "General Analysis" are applied to giving a uniform central theory for factorisation of different series of expressions.—G. E. **Hale**: The direction of rotation of sun-spot vortices. Of the two spots in the typical spot-pair the preceding spot in the low-latitude zone is counter-clockwise north, and clock-wise south, of the equator; corresponding to the direction of the rotation of terrestrial tornados. In high latitudes the signs are reversed, giving a result which is likely to prove significant in future studies of the sun.—G. E. **Hale** and G. P. **Luckey**: Some vortex experiments bearing on the nature of sun-spots and flocculi. Some of the phenomena of single and multiple sun-spots can be imitated by simple laboratory experiments, in which vortices are formed in a water-tank with an atmosphere of smoke above the water. Such experiments may assist in accounting for certain characteristic structures and motions of the solar atmosphere.

NEW SOUTH WALES.

Linnean Society, March 31.—Mr. A. G. Hamilton, president, in the chair.—**Esben-Petersen**: Australian Neuroptera. Part ii. This contribution deals with the Australian species of Myrmeleonidæ, comprised in fourteen genera; but the material available was insufficient for working out two of the large genera, Myrmeleon and Formicaleon. One genus and eight species are proposed as new.—G. I. **Playfair**: The genus Trachelomonas (Infusoria: fam. Euglenidæ, Stein). The extra-Australian records of the genus amount to a total of twenty-five published species of greater or less validity, and eight variations. Australian waters are very rich in forms of the genus, exhibiting a great variety of type.—E. **Breakwell**: The anatomical structure of some xerophytic native grasses. Grasses of eleven species, all but one from the Nyngan district, were studied.

April 28.—Mr. A. G. Hamilton, president, in the chair.—H. J. **Carter**: Descriptions of six new species of Buprestidæ (Coleoptera). The species described are referable to the genera Chalcotænia, Buprestis, Bubastes (2 spp.), Neocuris, and Stigmodera; all, with the exception of one species of Buprestis from Dorrigo, N.S.W., from Cue, West Australia.—G. F. **Hill**: Northern-territory Termitidæ. Part i. This contribution to a knowledge of the Australian Termitidæ has been prepared from part of a large collection of Termites, and many field-notes compiled during the past two years, in what may be termed the coastal region of the Northern Territory. Fifteen species are dealt with in this paper, eight of which are described as new. With the exception of one species of Eutermes, which builds a very small mound, all

the termites found in the Territory collect the great bulk of the earth and sand used in their termitaria, upon the surface.—T. **Steel**: The feeding-tracks of *Limax maximus*, Linn.

CAPE TOWN.

Royal Society of South Africa, May 19.—Dr. L. Péringuey, president, in the chair.—A. **Brown**: The equivalent mass of a spring vibrating longitudinally. The paper deals with the allowance to be made for the mass of a spring when a weight attached to it is oscillating under gravity and the tension of the spring. The fraction one-third of the spring's mass is correct for great added weights; for very small weights the fraction is a little over two-fifths. The variation of this fraction is considered theoretically, and data supplied to give its value for any weight. Experiments are described confirming the theoretical results.—A. W. **Rogers**: The occurrence of dinosaur bones in Bushmanland. Dinosaur bones were found in a well in Bushmanland at 112 ft. below the surface. The well is in an old valley cut in gneiss and filled in with local débris. It seems probable that the climate became dry while the dinosaurs lived there, and that since then the valley has been steadily filled up.—S. H. **Haughton**: Description of the dinosaur bones from Bushmanland. The bones discovered by Dr. Rogers consist of a maxillary tooth and portions of the hind limbs and caudal vertebra of a medium-sized Ornithopodous Dinosaur. They are described under the name Kangnasaurus Coetzeei n.g. et sp., which is shown to have affinities with Camptosaurus and its allies, and with Mochlodon and Hypsilophodon. The form is certainly younger than Camptosaurus, but no estimate of its exact age is given—the evidence being considered to be insufficient.—C. K. **Brain**: The Coccidæ of South Africa. The paper, which is the first contribution to a catalogue of the Coccidæ of South Africa, deals with five subfamilies, viz.:—Pseudococcinæ, Orthesiinæ, Coccinæ, Monophlebinæ, and Margarodinæ. Sixty-three species and two varieties are described, of which number thirty-two are here dealt with for the first time.—J. S. v. d. **Lingen**: A note on the molecules of liquid crystals. The object of the paper is to show the effect of bi-prisms on the Laue spots. Experiments carried out with prisms of NaCl show that the spots are "fluted," and that the central spot is elliptic instead of circular. 60° and 179° bi-prisms show this phenomenon, especially when they are rotated through a small angle.—J. S. v. d. **Lingen**: The "lines" within Röntgen interference photographs. The author holds that these lines are due to the ruptured surface, which will most probably resemble an echelon grating. Sodium chloride, quartz, silicon, and magnesium hydroxide photographs are described. These show "irregular spots" under certain conditions.

BOOKS RECEIVED.

Arithmetic. By C. Godfrey and E. A. Price. Parts i., ii., and iii. Complete. With Answers. Pp. xiii+467. (Cambridge: At the University Press.) 4*s.*

Typical Flies: a Photographic Atlas of Diptera, including Aphaniptera. By E. K. Pearce. Pp. xii+47. (Cambridge: At the University Press.) 5*s.* net.

Citizens To Be: a Social Study of Health, Wisdom, and Goodness. By M. L. V. Hughes. Pp. xvii+331. (London: Constable and Co., Ltd.) 4*s.* 6*d.* net.

The Natural History of the State: an Introduction to Political Science. By Prof. H. J. Ford. Pp. viii+188. (Princeton, U.S.A.: University Press; London: Oxford University Press.) 4*s.* 6*d.* net.

Ship Form, Resistance and Screw Propulsion. By G. S. Baker. Pp. vii+245. (London: Constable and Co., Ltd.) 12*s.* 6*d.* net.

Plain and Reinforced Concrete Arches. By Prof. J. Melan. Translated by Prof. D. B. Steinman. Pp. x+161. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 8*s.* 6*d.* net.

A History of British Mammals. By G. E. H. Barrett-Hamilton and M. A. C. Hinton. Part xvii. (London: Gurney and Jackson.) 2*s.* 6*d.* net.

Introduction to Heat. By A. R. Laws and Dr. G. W. Todd. Pp. x+212. (London: Mills and Boon.) 2*s.* 6*d.*

Scottish National Antarctic Expedition. Report on the Scientific Results of the Voyage of s.y. *Scotia* during the Years 1902, 1903, and 1904, under the Leadership of Dr. W. S. Bruce. Vol. iv. Zoology. Parts ii.–xx. Vertebrates. Pp. xii+505+plates. (Edinburgh: The Scottish Oceanographical Laboratory.) 50*s.*

Plane Geometry. By G. St. L. Carson and Prof. D. E. Smith. Part i. Pp. vi+266. Part ii. Pp. vi+259–482. (London and Boston: Ginn and Co.) 2*s.* 6*d.* each part.

Elements of Algebra. By G. St. L. Carson and Prof. D. E. Smith. Part ii. Pp. v+325–538. (London and Boston: Ginn and Co.) 2*s.* 6*d.*

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SUPPLEMENT TO "NATURE."

MEMBERS OF SCIENTIFIC STAFFS OF UNIVERSITIES, COLLEGES, AND OTHER INSTITUTIONS ON ACTIVE SERVICE WITH H.M. FORCES.

MANY of the universities, colleges, and technical institutions in the United Kingdom have prepared lists of members of the staff, and of past and present students, serving with the forces of the Crown during the present war. Men engaged in teaching scientific and technical subjects, or in research, at these institutions have, in common with other professional classes, put aside their work voluntarily at the call of their country and taken their places in various branches of naval or military service. It has been our sorrowful duty to record that several workers in science have met their deaths while thus employed; and on such occasions the thought of others in the field has always been before us. In order to obtain a rough census of men on active service, we have communicated with the registrar of each university and university college in the United Kingdom, and also with the principals of the technical schools and colleges included in the Association of Technical Institutions. We asked for the names of members of the scientific staffs now serving with the Army or Navy, with their positions on the staffs and rank in the forces. From the information thus obtained we have been able to compile the subjoined list, which will be of interest to many readers of NATURE.

Medical men have only been included in the list when their names have been sent in as those of members of general scientific staffs. It would be out of place for us to attempt to prepare a list of the thousands of medical men serving in the Royal Army Medical Corps, the work of which must command the admiration of the whole civilised world. We are also unable to give the names of the many men whose scientific and technical knowledge are being used in the provision of munitions of war and for other national services at home. One technical school informs us that its workshop is now turning out a large number of shells a week, and another that the three engineers on its staff are, in addition to their teaching duties, performing war service by making munitions in the engineering workshops connected with one of the Royal factories.

In presenting the subjoined list, it may be desirable to repeat that it is limited to members of scientific staffs of the institutions named. The number of past and present students serving with the King's forces is greater than could ever have been anticipated. The Oxford roll has 8000 names, Cambridge has nearly 9000, Edinburgh 4000, the Imperial College of Science and Technology 1200, and other universities and colleges are similarly represented. The recent report of the Board of Education for the year 1913–14 (Cd. 7934) gives some striking facts as regards the decrease thus caused in the number of students in English colleges. From thirty-four universities and university colleges in England and Wales which are aided by grants from the Board, 2530 full-time students, or about 30 per cent. of the total number of full-time men students, had withdrawn to join the Forces by the end of January, and it may be safely assumed from the activity of the Officers Training Corps attached to these institutions that the number will steadily increase. In the men's training colleges for elementary teachers (excluding university training departments) about 645 out of a total number of 1420, or about 45 per cent., are already serving with the Forces, and it may be anticipated that others will join, if required, at the conclusion of the summer term. For the technical, art, and evening schools it is not possible to give even approximate figures; but a number of the larger institutions have estimated the drop in the number of students owing to the war at points ranging up to 50 per cent., and averaging about 26 per cent.

ABERDEEN: UNIVERSITY.

Cranston, A., researcher in chemistry department, 2nd Lieut. 9th Batt. Royal Scots Fusiliers.
Duncan, Geo. M., lecturer in bacteriology, Capt. R.A.M.C. (T.F.)
Findlay, W. M., university assistant in agriculture, Lieut. Gordon Highlanders (T.F. Reserve).
Geddes, A. E. M., univ. assist. in natural philosophy, Lieut. Royal Army Flying Corps (Meteorl. Section).
Haig, Harold H., research fellow (pathology), Lieut. (Temporary), R.A.M.C.
MacQueen, J. M., research fellow (pathology), Capt. R.A.M.C. (T.F.)
Murray, Dr. J. R., university assistant in physiology, Lieut. (Temporary), R.A.M.C.
Orr, Dr. J. B., researcher in animal nutrition (Dept. of agriculture), Lieut. (Temporary) R.A.M.C.
Pratt, J. D., university assistant in chemistry, 2nd Lieut. 4th Batt. Gordon Highlanders (T.F.).
Stuart, G., university assistant in anatomy, Capt. R.A.M.C. (T.F.).
Thomson, A. L., univ. assist. in zool., 2nd Lt. (Temp.) 13th Batt. Argyll and Sutherland Highlanders.

ABERYSTWYTH: UNIVERSITY COLLEGE OF WALES.

Bury, assistant-lecturer and demonstrator in chemistry, 2nd Lieut. Gloucester Regiment.
Grant, R., county agriculture organiser for Pembrokeshire, 2nd Lieut. Welsh Regiment.
James, T. C., lecturer and demonstrator in chemistry, Lieut. College O.T.C.
Paine, H. H., assistant-lecturer and demonstrator in physics, Capt. Royal Welsh Fusiliers.
Walton, C. L., assistant-lecturer in economic zoology, 2nd Lieut. College O.T.C.
Williams, R. D., instructor in veterinary hygiene, Major Royal Army Veterinary Corps.

ASPATRIA AGRICULTURAL COLLEGE.

Charleton, L. S., lecturer in surveying and bookkeeping, Lieut.

ASTON: TECHNICAL SCHOOL.

Nash, J. H., teacher of mechanical drawing, private, Birmingham City Batt., 15th R. Warwick Regt.

BARROW: TECHNICAL INSTITUTE.

Baythorp, A. J., teacher of mechanical drawing, Lieut. Royal Garrison Artillery.
Milne, K., teacher of mechanical drawing, private, Yeomanry.
Seed, D., teacher of mechanical drawing, 2nd Lieut. Royal Garrison Artillery.

BELFAST: MUNICIPAL TECHNICAL INSTITUTE.

Adair, J. T., teacher of flax spinning, Lieut. Bedfordshire Regiment.
Forth, F. C., principal, Capt. Royal Irish Rifles.
Gooch, H., lecturer in physics and electrical engineering, Lieut. Royal Engineers.
Longworth, G. H., engineering workshop instructor, Staff-Sergt. Army Ordnance Corps.
Naylor, T. M., lecturer in mechanical and electrical engineering, Eng. Sub-Lieut. Royal Navy.
Nixon, W., teacher of naval architecture, Capt. Tyneside Scottish.

Stanley, R., professor of physics and electrical engineering, Capt. Royal Engineers.
Wright, T. M., instructor in physical training, Company Sergt.-Major Army Gymnastic Staff.

BELFAST: QUEEN'S UNIVERSITY.

Crymble, Dr. C. R., senior assistant in chemistry, Lieut. 3rd Batt. Royal Irish Fusiliers.
Crymble, P. T., lecturer in applied anatomy, Capt. R.A.M.C. (T.F.).
Dwerryhouse, Dr. A. R., lecturer in geology and geography, Capt. Royal Garrison Artillery (S.R.).
Emerson, E. C. T., demonstrator in anatomy, Lieut. R.A.M.C.
Glendinning, W. G., assistant in chemistry, despatch rider.
Gooch, H., extra Murch lecturer in electrical engineering, Lieut. Royal Engineers.
Harper, E. M., assistant in chemistry, 2nd Lieut. 7th Batt. Munster Fusiliers.
Livens, G., late demonstrator in botany, 2nd Lieut. 5th Batt. Wiltshire Regiment.
M'Cloy, Dr. J. M., assistant in pathology, medical officer in base hospital.
M'Connell, R. J., demonstrator in anatomy, Lieut. R.A.M.C.
Malcolm, H. P., demonstrator in pathology, Lieut. R.A.M.C.
Stanley, R., extra Murch professor of electrical engineering, Capt. Royal engineers.
Wilson, Dr. W. J., lecturer in hygiene, Lieut. R.A.M.C. (T.F.).

BIRMINGHAM: MUNICIPAL TECHNICAL SCHOOL.

Lawrence, R. R., laboratory assistant, metallurgical department, 2nd Lieut.
Legg, S., senior laboratory assistant, engineering department, private.

BRADFORD: TECHNICAL COLLEGE.

Chevalier, J. J. F., station engineer, 2nd Lieut. Mechanical Transport Section, A.S.C.
Rowell, H. S., senior lecturer, engineering department, 2nd Lieut. Royal Garrison Artillery.

BRISTOL: MERCHANT VENTURERS' TECHNICAL COLLEGE.

Chitty, H., lecturer on first aid and home nursing, surgeon, R.N.
Palmer, G. R., assistant-lecturer in mathematics, Lieut. 11th Batt. West Riding Regiment.
Rogers, Dr. B. M. H., lecturer on care of the infant and school child, Lieut.-Col. R.A.M.C.
Short, Dr. A. R., lecturer on first aid and home nursing, Capt. R.A.M.C.
Stanley, H., lecturer in physics, Lieut. 4th Batt. Gloucester Regiment.
Statham, Dr. R. S. S., demonstrator in first aid and home nursing, Lieut. R.A.M.C.
Tipton, F. N., lecturer on telegraphy, Army telegraphist in France.
Wood, E. B., research assistant in the automobile engineering dept., Lieut. Army Service Corps.

BURNLEY: MUNICIPAL TECHNICAL INSTITUTE.

Basnett, W., laboratory attendant, private R.A.M.C.
Kay, T. H., teacher of commercial subjects, private Army Service Corps.

BURY: MUNICIPAL TECHNICAL SCHOOL.

Brammall, A., head of commercial department, Corpl. (Army).
Brooks, A. W., lecturer in book-keeping, Sergt.-Maj. (Army).
Buxton, G. V., lecturer in mathematics, private (Army); killed in action June 6, 1915.
Catterall, T., head of physics department, 2nd Lieut. (Army).
Eastham, F., lecturer in physics, private (Army).
Hardman, E. S., lecturer in engineering, 2nd Lieut. (Army).
Johnson, J., head of building trades department, Corpl. (Army).
Norman, G. M., head of chemistry department, Corpl. (Army).
Tonge, H., assistant-lecturer in cotton weaving, Corpl. (Army).

CAMBRIDGE: UNIVERSITY.

Assheton, Dr. R. T., lecturer in animal embryology, 2nd Lieut. 1st Cambs.
Bragg, W. L., lecturer in natural sciences, 2nd Lieut. R.H.A. (Leics.).
Deighton, F., teacher of vaccination, Lieut. R.A.M.C.
Dunlop, J. G. M., assistant-lecturer in chemistry, Lieut. 2nd Dublin Fusiliers (died August 26, 1914).
Entwistle, F., second observer, the Observatory, Lieut.
Fay, C. R., Gilbey lecturer in agriculture, 2nd Lieut. 3rd The Buffs (East Kent Regiment).
Gray, J., demonstrator in comparative anatomy, 2nd Lieut. 5th Royal West Surrey.
Gregory, R. P., university lecturer in botany, Lieut.
Hele, T. Shirley, lecturer in natural sciences, Capt. R.A.M.C.
Heycock, C. T., Goldsmiths' reader in metallurgy, Lieut.-Col. Commanding 1st Cambs. (T.F.).
Hill, A. V., Humphrey Owen Jones lecturer in physical chemistry, Capt. 1st Cambs.
Hindle, E., assistant to Quick professor of biology, Lieut. R.E. (Signalling Section).
Hopkinson, B., professor of mechanism and applied mechanics, Major C.U.O.T.C.
Inglis, C. E., lecturer in mechanical engineering, Lieut. Royal Engineers.
Kempson, F. C., demonstrator of human anatomy, Lieut. R.A.M.C. (5th Bedford).
Lees, S., fellow of St. John's, Engineer-Lieut. R.N.
Littlewood, J. E., lecturer in mathematics, 2nd Lieut. R.G.A. (Wessex).
Lucas, Dr. K., demonstrator in physiology, Army Aircraft Factory.
Marrack, J. R. fellow of St. John's, working at the Research Hospital, Cambridge, Lieut. R.A.M.C.
Moss, W., junior observer, Solar Physics Observatory, Cadet Cambridge University O.T.C.
Myers, Dr. C. S., lecturer in experimental psychology, Major R.A.M.C.
Nicholas, T. C., sub-lecturer in geology, Staff-Major Mediterranean Force.
Parker, W. H., sub-lecturer in agriculture, 2nd Lieut. 11th Suffolk.
Peters, R. A., research fellow (physiology), Gonville and Caius, Univ. demonstrator, Lieut. R.A.M.C.
Potts, F. A., director in natural science, Trinity Hall, 2nd Lieut. 9th West Riding Regiment.
Roberts, H., lecturer in physiology and anatomy, Lieut. R.A.M.C.
Robertson, D. H., sub-lecturer in economics, 2nd. Lieut. 11th London.
Rolston, W. E., junior observer, Solar Physics Observatory, Lieut. East Kent Regt. (The Buffs).
Stratton, F. J. M., University lecturer in astrophysics, Capt. 20th Div. Syn. Co., R.E.
Thirkill, H., demonstrator in experimental physics, 2nd Lieut. R.E.
Thomas, H. H., curator of botanical museum, 2nd Lieut. Chesh. Brigade R.F.A.
Wilson, G. H. A., lecturer in mathematics, Capt. (Army).

Woodhead, G. Sims, professor of pathology, Lieut.-Col. R.A.M.C.
Wright, C. S., lecturer in surveying and cartography, 2nd Lieut. Royal Engineers.

CARDIFF: TECHNICAL SCHOOL.

Collier, R. H., teacher of motor-car engineering (elementary), Lieut. Royal Flying Corps.
Korner, L. J., teacher of oxy-acetylene welding and metal cutting, mechanic Royal Flying Corps.
Thain, T. E., teacher of marine engineering, Lieut. Royal Engineers.
Wiltshire, C. J., assistant-teacher of theoretical mathematics ii., private Royal Army Medical Corps.

CHELMSFORD: EAST ANGLIAN INSTITUTE OF AGRICULTURE.

Hunter Smith, J., agriculturist, private London Scottish, 2nd Batt.
Taylor, E. McK., analyst and lecturer in chemistry, Lieut. 5th Essex (T.F.).

CHESHIRE: HOLMES CHAPEL COLLEGE OF AGRICULTURE.

Gadd, C. H., lecturer in biology, Lance-Corporal Public School Batt. Royal Fusiliers.
Mansfield, W. S., soil chemist, Lieut. 5th Dragoon Guards.
Smith, F. Y., assistant in biology, 2nd Lieut. Royal Field Artillery.
Steele, D., assistant in agriculture, Lieut. Denbigh Hussars.

CIRENCESTER: ROYAL AGRICULTURAL COLLEGE.

Duncan, A. C., prof. of vet. sci. and bac., Lieut. attached 1st Regt. Royal Glos. Regt.
Hopkinson, A. D., lecturer in forestry, 2nd Lieut. 4th Batt. Gordon Highlanders (twice wounded).
Kershaw, M., lect. in physics and asst. lect. in chemistry, 2nd Lieut. Special Reserve (Glos. Regt.).
Saunders, C. B., lecturer in botany, 2nd Lieut. 9th Batt. the Buffs.

CORK: UNIVERSITY COLLEGE.

Cummins, Dr. H. A., professor of botany and agriculture, Major.
Harper, E. H., professor of applied mathematics, Lieut.
Magner, W., demonstrator in pathology, Lieut. R.A.M.C.
Pearson, C. B., demonstrator in surgery, Lieut. R.A.M.C.

COVENTRY: MUNICIPAL TECHNICAL INSTITUTE.

Morris, F., teacher of engineering, Lieut. Army Ordnance Corps.

CROYDON: POLYTECHNIC.

Baillie, Dr. T. C., principal, Lieut. Royal Garrison Artillery.
Price, E. C., instructor in wireless telegraphy, Sergt.-Major Royal Engineers.

EDINBURGH: EDINBURGH AND EAST OF SCOTLAND COLLEGE OF AGRICULTURE.

Bain, Dr. D., assistant-lecturer in chemistry, Sergt. Lothians and Border Horse.
Gray, M. W., research assistant in chemistry, 2nd Lieut. Scottish Horse.
Macpherson, A., assistant-lecturer in biology, trooper Lothians and Border Horse.
Steele, J. T., county lecturer in agriculture, 2nd Lieut. Scottish Horse.
Walker, J., assistant county lecturer in agriculture, Corpl. Lothians and Border Horse.
Wilson, A. F., county lecturer in agriculture, 2nd Lieut. Army Service Corps.

EDINBURGH: HERIOT-WATT COLLEGE.

Aitken, J. E., lecturer on paper manufacture, Capt. Royal Scots.
Bennet, G., demonstrator, mechanical engineering department, first-grade mechanic, R.N.A.S.
Malpas, T. G., assistant-lecturer in physics department, Lieut. 14th Royal Scots.
O'Connor, H., lecturer on gas manufacture and gas supply, Lieut.-Col. Royal Garrison Artillery (T.F.).
Ogilvie, A., lecturer on electrical wiring, Major Royal Engineers (T.F.).
White, J. L., lecturer on mechanics and mathematics, Private 'Lothians and Border Horse.

EDINBURGH: UNIVERSITY.

Beesly, Lewis, demonstrator in anatomy, Capt. R.A.M.C.
Bennet, W. G., assistant in chemistry, 2nd Lieut. Royal Field Artillery.
Finlay, T. M., lecturer in geology, Lance-Corpl. Scottish Horse.
Horne, R. J. M., assistant in physiology, Major Forth Royal Garrison Artillery.
Lyon, D. M., assistant in pathology, Lieut. R.A.M.C., 5th Cavalry Field Ambulance.
Mackenzie, Dr. J. E., lecturer in chemistry, Major Artillery Unit O.T.C., and Adjutant of Corps.
Mackie, John, assistant in natural philosophy, 2nd Lieut. 8th Royal Scots.
Mitchell, W. M., assistant in comparative anatomy, Lieut. Royal Army Veterinary Corps.
Todd, J. B., lecturer in engineering, Capt. Artillery Unit O.T.C.
Watson, J. A. S., lecturer in agriculture, Quarter-Master-Sergeant, Lothians and Border Horse.

EXETER: UNIVERSITY COLLEGE.

Jervis, W. W., lecturer on mathematics and geography, 2nd Lieut. 4th Devon Regiment.

GLASGOW: ROYAL TECHNICAL COLLEGE.

Agnew, J. W., lecturer in chemistry, 2nd Lieut. Highland Light Infantry (killed in action).
Bourdon, E., professor of architectural design, Staff-Capt. in French Army.
Burns, W. S., demonstrator in natural philosophy, 2nd Lieut. R.E.
Crawford, C. M'L., technical instructor, mechanic Royal Naval Air Service.
Duncan, T. B., assistant-lecturer and demonstrator in natural philosophy, 2nd Lieut. Scottish Rifles.
Ellis, A., lecturer in navigation, Lieut. R.N.M.B.R. (drowned on service).
Fraser, H., assistant-lecturer and demonstrator in mechanics, 2nd Lieut. South Wales Borderers.
Gardham, H. C., lecturer in mechanics, Lieut. Royal Field Artillery.
Gray, W. C., lecturer in metallurgy, 2nd Lieut. Highland Light Infantry.
Hardie, A. G., lecturer in tanning, trooper Lothian and Border Horse.
Heilbron, I. M., lecturer in chemistry, Capt. A.S.C.
Hossack, J. M., technical instructor, Company Quarter-Master-Sergeant H.L.I.
King, L. A. L., lecturer in zoology, Lieut. Royal Field Artillery.
Macdonald, A., signalling instructor, Chief Yeoman of Signals, R.N.
M'Donald, A., lecturer in navigation, Lieut. R.N.M.B.R.
M'Lellan, R. S., lecturer in navigation, Sub-Lieut. R.N.R.
O'Connor, H., lecturer in gas engineering, Lieut.-Col. Royal Garrison Artillery.

Paul, J., lecturer in mathematics, despatch rider, Royal Engineers.
Sinclair, J. H., lecturer in engineering drawing, Bombardier Motor Machine Guns, R.F.A.
Walsh, R. E., assistant-lecturer in mechanics, 2nd Lieut. Royal Engineers.
Warden, H., technical instructor, Staff-Sergt. A.O.C.
Wilson, Dr. F. J., lecturer in chemistry, Capt. H.L.I.

GLASGOW: UNIVERSITY.

Agar, Dr. W. E., lecturer in zoology, Capt. and Adjt. 5th (Reserve) H.L.I.
Drummond, J. M. F., lecturer in botany, Cadet Inns of Court O.T.C.
Dunkerly, J. S., lecturer in protozoology, 2nd Lieut. 12th Scottish Rifles (Cameronians).
Ferguson, D. R., assistant in engineering, private Royal Engineers.

GLASGOW: WEST OF SCOTLAND AGRICULTURAL COLLEGE.

Fraser, J., lecturer on forestry and forest botany, private Argyll and Sutherland Highlanders.
Gillilland, T., assistant at Dairy School, trooper Scottish Horse.
King, L. A. L., lecturer in zoology, Lieut. Royal Field Artillery.
Kirkpatrick, W., junior assistant in agriculture, Corpl. Scottish Horse.
Kirkwood, J., assistant extension lecturer, despatch rider.
Malcolm, J. F., lecturer on bacteriology, Lieut. Royal Field Artillery.
McCall, J. R., professor and lecturer on veterinary science, Lieut. Royal Field Artillery.
Murray, A., extension lecturer, Lieut. Scottish Horse.
M'William, P.A., extension lecturer, Quarter-Master-Sergt. Ayrshire Yeomanry.
Perry, B. P., assistant in horticultural department, Royal Naval Volunteer Reserve Rifles.
Smith, J. W., assistant-superintendent, Experiment Station, Sergt. Ayrshire Yeomanry.

GLOUCESTER: TECHNICAL SCHOOL.

Brown, A. D., teacher of physics and applied mechanics, Sergt.

HALIFAX: MUNICIPAL TECHNICAL COLLEGE.

Blakey, E. V., assistant, chemistry department, 2nd Lieut. 3rd West Riding.
Park, H. E., laboratory assistant, electrical engineering department, private, Electrical Section, R.E.
Platt, B., assistant in mathematical department, 2nd Lieut. Royal Engineers.
Ramsden, E., assistant, mechanical engineering department, 2nd Lieut.
Sadd, J. A., head of civil and mechanical engineering department, private in Sanitary Corps.
Smith, E. W., head of chemistry department, private in Sanitary Corps.

HANDSWORTH: TECHNICAL SCHOOL.

Hilbourne, G. W., lecturer in mathematics, Lieut. in Army.
Vallance, R. F., lecturer in chemistry, private in Army.

HARPENDEN: THE ROTHAMSTED LABORATORY.

Bowden, A. H., laboratory assistant, private in Army.
Clayton, J., bacteriologist, Lieut. in Army.
Daish, A. J., organic chemist, Lieut. in Army (wounded on May 16).
Gregory, E. H., voluntary assistant on Demonstration Farm, 2nd Lieut. attached 3rd Suffolk Regiment.
Keen, B. A., soil physicist, 2nd Lieut. in Army.
Lawrence, G., laboratory assistant, Sergt. in Army.
Lewin, K. R., protozoologist, 2nd Lieut. in Army.
MacLennan, K., bacteriologist, Lieut. in Army.
Martin, C. H., voluntary worker in protozoology, Lt. in Army (killed in action near Ypres on May 3).

HUDDERSFIELD: TECHNICAL COLLEGE.

Tetley, E. W., assistant-lecturer in weaving and designing, Lance-Corpl.

HULL: MUNICIPAL TECHNICAL COLLEGE.

Dennis, W. E., demonstrator in physics department, 2nd Lieut. 9th East Yorks.
Wolff, L., assistant-lecturer in chemistry, private in East Riding Yeomanry.

LANCASTER: STOREY INSTITUTE.

Ewan, R. F., lecturer in pure mathematics, Corpl. 5th King's Own Lancaster Regiment.
Forshaw, W. S., lecturer in physics, Lieut. Manchester Regiment.
Irving, R., lecturer in practical mathematics and engineering drawing, pte. 5th King's Own Lancs.

LIVERPOOL: UNIVERSITY.

Allmand, A. J., assistant-lecturer in chemistry, 2nd Lieut. 5th Batt. Cheshire Regiment.
Angelbeck, A., tutor in geography, 2nd Lieut. 16th Service Batt. the King's Liverpool Regiment.
Balfour, W. M., assistant-lecturer in naval architecture, 2nd Lieut. Royal Garrison Artillery.
Bengough, G. D., lecturer in metallurgy, Capt. Royal Garrison Artillery.
Burfield, S. T., assistant-lecturer in zoology, 2nd Lieut. 8th Irish Batt. the King's Liverpool Regt.
Clark, J. J., assistant-lecturer in engineering design and drawing, Sergt. Cheshire Field Co., R.E.
Dod, H. A., instructor in architecture, 2nd Lieut. 18th Service Batt. the King's Liverpool Regiment.
Garstang, J., professor of archæology, inspector of twenty-five hospitals under the French Red Cross.
Harvey-Gibson, R. J., professor of botany, Lieut.-Col. the King's Liverpool Regt.
Newberry, P. E., professor of archæology, special war service.
Newstead, R., professor of entomology, special sanitation work in France.
Turnbull, G. H., assistant-lecturer in education, 10th Scottish Batt. the King's Liverpool Regiment.
Yorke, W., professor of parasitology, special Government work.

LONDON: ALDGATE, E.C., THE SIR JOHN CASS TECHNICAL INSTITUTE.

Abbot, H., lecturer on fermentation industries, 2nd Lieut. Royal Field Artillery.
Hill, S. E., assistant-teacher of physics, 20th Batt. County of London (rank unknown).
Kibble, A. W., lecturer on the fermentation industries, Sergt. Artists' Rifles.

LONDON: BATTERSEA POLYTECNIC.

Brill, D., mechanical engineering workshop assistant, private.
Curnock, W. E. M., head of department of mechanical and civil engineering, Lieut. in Army.
Godsmark, A. E., electrical engineering steward, private.
Hall, H. H., chemistry steward, private.
Matterface, J., chemistry laboratory assistant, private.
Porter, W. J., assistant-lecturer in electrical engineering, private.

LONDON: L.C.C. BEAUFOY TECHNICAL INSTITUTE.

Mitchell, J., lecturer on applied mechanics, sapper Royal Garrison Artillery.

LONDON: BOROUGH POLYTECHNIC INSTITUTE.

Chapman, E. H., assistant-lecturer in mathematical department, special meteorological work.
Cooper, W. N., assistant-lecturer in engineering department, 2nd Lieut. the Buffs.

LONDON: BRIXTON, L.C.C. SCHOOL OF BUILDING.

Bull, W. J. H., assistant science teacher, 2nd Lieut. North Staffordshire Regiment, R.M.C., Woolwich.
Freeman, R. L., teacher of quantity and land surveying, Staff-Sergt.-Major, Army Service Corps.
Murrell, H. F., teacher (assistant) of architecture, Lieut. Artists' Rifles (28th County of London).

LONDON: CHELSEA, SOUTH-WESTERN POLYTECHNIC INSTITUTE.

Nicholas, T. C., lecturer in geology (at Alexandria engaged in map drawing).
Scott, J. M., lecturer in building construction and drawing, London Scottish.

LONDON: EAST LONDON COLLEGE (UNIVERSITY OF LONDON).

Cannan, R. K., demonstrator in chemical department, 2nd Lieut. (wounded at Hill 60).
Lamb, E. H., University professor of civil and mechanical engineering, Lieut. Royal Marines.
Thurston, Dr. A. P., lecturer, aeronautical department, private London Electricals (Royal Engineers).

LONDON: GREENWICH, ROYAL OBSERVATORY.

Baldwin, G. C., computer, private.
Barton, H. H., computer, private.
Berry, A. W., computer, private.
Burkett, W. W., junior assistant, Lieut.
Chamberlain, E. A., computer, private.
Davies, W. G., computer, private.
Davis, H. W., computer, private.
Divers, S. T., computer, Quarter-Master-Sergt.
Kilby, H. H., computer, private.
Lambert, W. A., computer, private.
Percival, W. G., computer, private.
Perry, P., computer, private.
Sims, R. L., computer, private.
Symms, L. S., computer, private.
Vaizey, G. R., computer, private.
Whitaker, F., computer, private.
White, P. J., computer, private.

LONDON: HACKNEY, L.C.C. INSTITUTE.

Hughes, B., lecturer in building construction, private Royal Army Medical Corps.
Ridley, W. O., lecturer in electrical engineering, Sergt., employed in wireless telegraphy work.
Webster, F. C., lecturer in building construction, Sergt. London Scottish.

LONDON: KING'S COLLEGE.

Boyd, Dr. S., lecturer in applied anatomy, 2nd Lieut. R.A.M.C. (T.F.).
Brown, Dr. Wm., reader in psychology, Lieut. 17th General Hospital, 29th Div. B. Med. Exp. Force.
Capper, D. S., professor of engineering, Lieut.-Col. Commanding University O.T.C.
Charles, Rhys, lecturer in public health, Lieut.-Col. 2nd City of London Royal Fusiliers.
de Souza, Dr. D. H., lecturer in physiology, Capt. R.A.M.C., 4th London General Hospital.
Dixon, Dr. W. E., professor of pharmacology, special service.
Hare, Dr. J. Gilbert, demonstrator in bacteriology, Red Cross Hospital.
Morrell, W. P., tutor in mathematics, 'Lance-Corpl. 13th Batt. Yorks. and Lancs.
Wright, T., demonstrator in chemistry, 2nd Lieut. 3rd Royal Berks. (killed in action).

'LONDON: NEW CROSS, GOLDSMITHS' COLLEGE.

Fitzgerald, E., science lecturer, Capt. 20th County of London Regiment.

LONDON: NORTHAMPTON POLYTECHNIC INSTITUTE.

Barlow, E., demonstrator, electrical engineering department, Sapper R.N. Division, Engineers.
Boraston, C. A., demonstrator, electrical engineering department, 2nd Lieut. Divisional Engineers.
Hayes, M. E., assistant, mechanical engineering department, private 4th Royal Fusiliers.
Parnell, A. P., demonstrator, technical optics department, private 10th Royal Fusiliers.
Simmons, G. S., assistant, technical optics department, private 7th Middlesex.
Ware, W. J. K., assistant, technical chemistry department, private 4th West Surrey.

LONDON: NORTHERN POLYTECHNIC INSTITUTE.

Giles, A. M., physics lecturer, 2nd Lieut. Royal Engineers.

LONDON: NORWOOD, L.C.C. TECHNICAL INSTITUTE.

Cowley, H., teacher of horticulture, private 12th City of London Regiment (The Rangers).

LONDON: PADDINGTON, L.C.C. TECHNICAL INSTITUTE.

Bagenal, P. H., lecturer in architecture, private R.A.M.C.
Brown, W., lecturer in physics, Lieut.
Clarke, R. Balfour, demonstrator in engineering, 2nd Lieut. Army Service Corps.
Dearing, C., lecturer in physics and botany, private 'London Rifle Brigade.
Fenning, R. W., lecturer in engineering, 2nd Lieut. Artists' Rifles.
Freeman, R. L., lecturer in surveying, 2nd Lieut. Royal Engineers.
Hough, H. W., laboratory assistant, electrical engineering and physics dept., sapper R.E. (Elec.).
Morrow, H. E., lecturer in engineering, 'Lieut. Royal Naval Division.
Norman, H., instructor in electrical engineering, mechanic, Royal Engineers (Elec.).
Purser, W., instructor in engineering, Sergt. Royal Engineers.
Snell, A., demonstrator in engineering, mechanic, Royal Engineers.

LONDON: POPLAR, L.C.C. SCHOOL OF ENGINEERING AND NAVIGATION.

Enness, F. C., chemical laboratory assistant, private Duke of Cornwall's Light Infantry.
Gordon, D., pattern-making instructor, Lieut. Royal Naval Aircraft Service.
Palmer, F. E., drawing office assistant, sapper Royal Engineers Unit Royal Naval Division.
Pull, E., engineering workshop instructor, Warrant Engineer, Royal Navy.
Steele, J. E., naval architecture lecturer, Lieut. Royal Naval Aircraft Service.
Walker, C. A., engineering workship instructor, sapper Royal Engineers Unit Royal Naval Division.
Witney, A. H., navigation teacher, Corpl. Royal Field Artillery.

LONDON: ROYAL HORTICULTURAL SOCIETY'S LABORATORY.

Page, H. J., chemist, Lieut. Royal Artillery.

LONDON: SOUTH KENSINGTON, CITY AND GUILDS (ENGINEERING) COLLEGE.

Box, R. L., assistant demonstrator in mechanical engineering, Lance-Corpl., London Elec. Engineers.
Dickson, T. W., lecturer in mathematics and mechanics, 2nd Lieut. Jersey Militia.

Fields-Clarke, P. C. E., assistant-demonstrator in civil eng. and surveying, 2nd Lieut. 2nd Lancs Regt.
Hall, A. H., assistant-demonstrator in electrical engineering, Capt. Essex Regiment.
Hatfield, M. B., assistant-demonstrator in mechanical engineering, private Seaforth Highlanders.
Haworth, H. F., demonstrator in electrical engineering, Lieut. London Electrical Engineers (T.F.).
Klugh, H., assistant-professor in mechanics and mathematics, Sub-Lieut. R.N.V.R.
Newton, K., demonstrator in mechanical engineering, 2nd Lieut. Royal Garrison Artillery.
Pottle, A. E., assistant-demonstrator in electrical engineering, private Hampshire Regiment.
Purser, J. W., assistant-professor of civil engineering and surveying, Sub-Lieut. R.N.V.R.
Sproull, A. W., assistant-demonstrator in civil engineering and surveying, 2nd. Lieut. 127th Field Co., R.E.
Tapster, A. G., assistant-demonstrator in mechanical eng. private, 2nd Batt. 13th Co. of London Regt.
Whittaker, H., lecturer in mechanical engineering, 2nd Lieut. Royal Engineers.

LONDON: SOUTH KENSINGTON, ROYAL COLLEGE OF SCIENCE.

Curtis, W. E., demonstrator in physics, sapper Royal Naval Engineers.
Finch, G., demonstrator in chemical technology, 2nd Lieut. Royal Garrison Artillery.
Fox, H. M., lecturer in biology, 2nd Lieut. Army Service Corps.
Gibbs, I. R., assistant-demonstrator in chemistry, 1st Lieut. 10th Gloucester Regiment.
Jones, B. M., assistant-professor in chemistry, 1st Lieut., attached to Headquarters.
Lewis, R. C., assistant-demonstrator in biology, 2nd Lieut. 1st Batt. Royal Berks Regiment.
Richardson, A. R., assistant-professor in mathematics and mechanics, Maj., Headqrs., No. 1 Base, B.E.F.
Sladden, C. E., assistant-demonstrator in chemistry, 2nd Lieut. Worcester Regiment.

LONDON: SOUTH KENSINGTON, ROYAL SCHOOL OF MINES.

Chapple, H. M., demonstrator in metallurgy, Motor Cycle Division, Admir. Br. Air Service.
Courtman, E. O., demonstrator in metallurgy, Capt University of London O.T.C.
Holman, B. W., demonstrator in mining, 2nd Lieut. Royal Engineers.
Merrett, W. H., assistant-professor in metallurgy, Capt. London Electrical Engineers.

LONDON: SOUTH KENSINGTON, NATURAL HISTORY MUSEUM.

Austen, E. E., assistant, Capt. 28th (Artists' Rifles) London Regt. (attached to Army Sanitary Corps).
Blair, K. G., assistant, private 4th Seaforth Highlanders.
Dollman, J. G., assistant, private Inns of Court Officers Training Corps.
Edwards, W. N., assistant, private R.A.M.C., 3rd East Anglian Field Ambulance.
Riley, N. D., assistant, Lieut. Army Service Corps.
Smith, W. Campbell, assistant, Lieut. 28th (Artists' Rifles) London Regiment.
Stammwitz, P., taxidermist, trooper 1st County of London Yeomanry (Middlesex Hussars).
Totton, A. K., assistant, Lieut. Duke of Cornwall's Light Infantry.
Treatt, C. C., assistant, Lieut. Royal Army Flying Corps.
Wernham, H. F., assistant, private 28th (Artists' Rifles) London Regiment.

LONDON: UNIVERSITY COLLEGE.

Aveling, Rev. F., lecturer in synthetic psychology, Chaplain, 55th Division.
Crymble, Dr. C. R., demonstrator in chemistry, assistant chemical physiology, Lieut. 3rd R. I. Fusiliers.
Derry, D. E., demonstrator in anatomy, lecturer in physical anthropology, Lieut. R.A.M.C.
Filon, Prof. L. N. G., prof. of app. maths. and mech., Maj. 2nd Batt. 4th City of London Regt., R.F.
Foulerton, A. R. G., lecturer, hygiene and public health, Capt. R.A.M.C. (Sanitation Commission).
Goodbody, Dr. F. W., asst. prof. path. chemistry, Capt. R.A.M.C., attached 28th Co. of London Regt.
Green, C. M., assistant in botany, 2nd Lieut. Royal Sussex Regiment (wounded).
Gunn, J. W. C., assistant, pharmacology, Lieut. R.A.M.C.
Hill, T. G., reader in plant physiology, Capt.-Adjt. University of London O.T.C.
Jameson, Dr. W. W., assistant and lecturer, hygiene and public health, Lieut. R.A.M.C.
Kenwood, Prof. H. R., professor of hygiene and public health, Lieut.-Col. R.A.M.C. (Sanitation Commis.).
Mant, H. T., demonstrator in anatomy, lecturer in surgical anatomy, Lieut. R.A.M.C.
Simmons, E. W., demonstrator in geology, 2nd Lieut. 6th York and Lancaster Regiment.
Slade, Dr. R. E., assistant in chemistry, 2nd Lieut. Univ. of London O.T.C., special service in France.
Spearman, Prof. C., Grote professor of philosophy of mind and logic, Major, General Staff.
Venn, H. J. P., demonstrator in chemistry, Sub-Lieut. Royal Naval Division.

LONDON: WEST HAM TECHNICAL INSTITUTE.

Clarke, F. C., lecturer in mathematics, Capt. London Electrical Engineers.
Cresswell, W. T., lecturer in building construction and quantities, Major R.E.
Martin, L. C., assistant-lecturer in physics department, private R.N.D., Deal Batt.
Miller, C. P., demonstrator, civil and mechanical engineer. dept., 2nd Lieut. York. and Lancs. Regt.

LONDON: WESTMINSTER, L.C.C. TECHNICAL INSTITUTE.

Benslyn, W. T., architectural department, sapper Royal Engineers.
Bevis, J., gas engineering department, Corpl. Cyclist Batt. London Regiment.
Creswell, W. T., architectural department, Capt. Royal Engineers.
Gough, H. J., civil engineering department (rank unknown).
Webster, F. C., architectural department, Pioneer Sergt. London Scottish.

LONDON: WOOLWICH POLYTECHNIC.

Barry, P. L., chemical laboratory steward, rifleman (Q.V.R.).
Dunger, H. C. physical laboratory steward and instrument maker, Staff-Sergt. Army Ordnance Corps.
Elliott, H., lecturer in engineering, Lieut.
Franklin, P. C., lecturer in mathematics, Capt. Army Service Corps.
Frier, G. D., engineering laboratory attendant, private 20th London Regiment.
Honeybourne, H. C., assistant-teacher, physics, Capt. 20th London Regiment.
Little, E., lecturer in mathematics, Capt. Army Service Corps.
Otto, C. A., woodwork instructor and pattern-maker, sapper Royal Engineers.

LOUGHBOROUGH: TECHNICAL INSTITUTE.

Dyche-Teague, D. R., lecturer in machine construction, engineer-artificer in Navy.
Harris, J. W., lecturer in chemistry, 2nd Lieut. Yorks and Lancs.
King, J., lecturer in chemistry, 2nd Lieut. Yorks and Lancs.

MANCHESTER: SCHOOL OF TECHNOLOGY.

Gamble, C. W., director of photography and printing crafts department, Lieut. Royal Naval Volun. Res.
Hoyle, B., demonstrator in the school of technology, Lance-Corpl. Royal Engineers.
Lees, S., reader in applied thermodynamics, Eng.-Lieut. Royal Navy.
Wilson, S. P., demonstrator in the sch. of tech., 2nd Lieut. 10th (Service) Batt. South Lancs. Regt.

MANCHESTER: UNIVERSITY.

Cook, G., junior demonstrator in engineering, 2nd Lieut. Royal Garrison Artillery.
Edgar, E. C., senior lecturer in chemistry, 2nd Lieut. Manchester Univ. O.T.C. (Unattached List T.F.).
Florance, D. C. H., lecturer and demonstrator in physics, 2nd Lieut. 16th Div. Royal Field Artillery.
Holland, Sir T. H., prof. of geol., C.O. of Manchester Univ. O.T.C., Major (Unattached List, T.F.).
Jones, W. J., assistant-lecturer and demonstrator in chem., 2nd. Lieut. 12th (S.) Batt. Royal Welsh Fus.
Partington, J. R., assist.-lect. and demon. in chem., 2nd Lieut. 12th (S.) Batt. Royal Welsh Fusiliers.
Pring, J. A., demonstrator in electro-chemistry, Lieut. 8th (S.) Batt. Royal Fusiliers.
Robinson, H., lecturer and demonstrator in physics, 2nd Lieut. Royal Garrison Artillery.
Wardle, R. A., lecturer in economic zoology, private, Public Schools and Univ. Corps, Royal Fusiliers.

NEWCASTLE-UPON-TYNE: ARMSTRONG COLLEGE.

Gallon, J., prize demonstrator in mining, etc., 2nd Lieut.
Garrett, F. C., lecturer in chemistry, Lieut-Col.
Hall, A. A., assistant-lecturer in agricultural chemistry, 2nd Lieut.
Little, W. B., instructor in horticulture, Capt.
Morris-Airey, H., lecturer in physics, Lieut. Royal Naval Volunteer Reserve.
Peacock, A. D., lecturer in zoology, Sergt.
Poulton, J. H., prize demonstrator in physics, Sergt.
Ramsbottom, J. W., lecturer in economics, 2nd Lieut.
Small, J., demonstrator in botany, Corpl.
Thompson, L. A., assistant-lecturer in agriculture, 2nd Lieut.
Thompson, L. M., prize demonstrator in geology, 2nd Lieut.

NORWICH: TECHNICAL INSTITUTE.

Pond, E. W., electrical engineering assistant, private.

NOTTINGHAM: UNIVERSITY COLLEGE.

Black, T. P., registrar, late physical department, Capt.
Inchley, W., mathematics and mechanical engineering, 2nd Lieut.
Lambourne, H., chemical demonstrator, 2nd Lieut.
Piper, S. H., physical demonstrator, Lieut.
Smalley, W. M., assistant chemical demonstrator, 2nd Lieut. (killed in action December 9, 1914).

OXFORD: UNIVERSITY.

Adams, P. E. H., reader in ophthalmology, Capt. R.A.M.C.
Bazett, H. C., demonstrator in pathology, Lieut. R.A.M.C., No. 8 Field Ambulance, B.E.F.
Bourne, Dr. G. C., Linacre professor of comparative anatomy, Major 12th Worcesters.
Buxton, L. H. D., demonstrator in physical anthropology, 2nd Lieut. 4th Cameron Highlanders.
Collier, W., Litchfield lecturer in medicine, Maj. R.A.M.C.
Dodds-Parker, A. P., Litchfield lecturer in surgery, lecturer in applied anatomy, Lieut.-Col. R.A.M.C.
Douglas, Dr. C. G., demonstrator in physiology, Lieut. R.A.M.C.
Douglas, J. A., demonstrator in geology, 2nd Lieut. 3rd Gordon Highlanders.
Dreyer, G., professor of pathology, hon. consulting pathologist, 3rd Southern General Hospital.
Foster, E. C., asst. demon. in human anatomy, Major R.A.M.C., registrar 3rd Southern General Hospital.
Gibson, Dr. A. G., lecturer in morbid anatomy, Capt. R.A.M.C.
Gill, W. B., demonstrator in physics, Lieut. R.G.A.
Gunn, J. A., reader in pharmacology, Lieut. R.A.M.C.
Hasell, E. W., demonstrator in rural economy, Lieut. Westmorland and Cumberland Yeomanry.
Jenkin, C. F., professor of engineering science, Lieut. R.N.V.R. (Air Service).
Jenkinson, Dr. J. W., lecturer in embryology, Capt. 12th Worcesters, attached 2nd Roy. Dub. Fusiliers (killed in action at Dardanelles, June 4, 1915).
Ogilvie, A. G., demonstrator in geography, Lieut. 7th London Brigade, Royal Field Artillery.
Osler, Sir W., regius prof. of medicine, Hon. Col. S. Midland Division R.A.M.C.
Smith, G. W., demonstrator in comparative anatomy, Capt. 13th Rifle Brigade.
Tizard, H. T., demonstrator in physics, 2nd Lieut. Royal Garrison Artillery, attached R.F.C.
Townsend, J. S. E., Wykeham professor of physics, Lieut. R.N.V.R. (Air Service).
Walker, Dr. E. W. A., lecturer in pathology, hon. consulting pathologist, 3rd Southern Gen. Hospital.

PLYMOUTH: TECHNICAL SCHOOL.

Riley, T. N., lecturer in electrical engineering, Lieut. Naval Division (Engineers).

PORTSMOUTH: MUNICIPAL COLLEGE.

Davies, H., head of mathematical physics and electrical engineering department, Capt. Royal Eng.
Grant, L., demonstrator in physics, sapper, Hampshire Fortress, Royal Engineers.
Howes, A., lecturer in mathematics, Sergt.-Instructor 12th Batt. Essex Regiment.
Kerrison, A. V., lecturer in mathematics and physics, 2nd Lieut. Royal Garrison Artillery.
Lineham, E., lecturer in mathematics, private Mechanical Transport, Army Service Corps.
Maltby, O. B., lecturer in engineering, Lieut. Border Regiment.

READING: UNIVERSITY COLLEGE.

Auld, S. J. M., professor of agricultural chemistry, Lieut. 4th Batt. Royal Berks.
Bartlett, H. J., lecturer in geography, Sergt. 2nd South Midland Brigade, Army Service Corps.
Carter, R. H., agricultural analyst, private 1st London (City of London) Sanitary Company, R.A.M.C.
Cole, F. J., professor of zoology, 2nd Lieut. O.T.C.
Golding, J., research chemist in dairying, Lieut. R.A.M.C.
Hart-Synnot, R. V. O., dean of agriculture, Capt. 2nd Batt. (Royal Guernsey) Channel Islands Militia.
Hitchins, W. W., lecturer in building construction and surveying, sapper.
Lewin, R. R., lecturer in agricultural botany, 2nd Lieut. 3rd Batt. Royal Sussex Regiment.
McLaren, S. B., professor of mathematics, 2nd Lieut. 39th Divisional Signal Co. (Reading) Royal Eng.

Pearson, R. L., lecturer in physics, Capt. 39th Divisional Signal Co. (Reading) Royal Engineers.
Stedman, G. P. W., lecturer in machine construction and drawing, Col.-Sergt. 4th Batt. Royal Berks.

ROCHDALE: TECHNICAL SCHOOL.

Amos, P. A., lecturer on flour milling (rank unknown).
Percival, T., teacher of practical mathematics, Sergt.
Shepherd, W., assistant in chemistry, private R.A.M.C.

ST. ANDREWS: UNIVERSITY.

Butchart, R. K., assistant to the professor of mathematics, 2nd Lieut. 14th (S.) Batt. the Royal Scots.
Caldwell, J. R., assistant to the professor of pathology, Lieut. R.A.M.C. (Special Reserve).
Gibson, Dr. A. H., professor of engineering, Lieut. Royal Garrison Artillery.
Hewitt, J. A., assistant to the professor of physiology, 2nd Lieut. Royal Field Artillery.
Shann, E. W., lecturer in comparative embryology, 2nd Lieut. 12th (S.) Batt. Northumberland Fusiliers.

ST. HELENS: MUNICIPAL TECHNICAL SCHOOL.

Groves, C. R., lecturer in metallurgy, private.

SALOP: HARPER-ADAMS AGRICULTURAL COLLEGE, NEWPORT.

Powell, J. D., assistant-lecturer in agriculture, trooper.
Rhodes, F. W., lecturer in poultry-keeping, 2nd Lieut.
Urquhart, J. C., assistant-lecturer in chemistry, Lieut.
Wilson, W. T., lecturer in veterinary hygiene, Lieut.

SHEFFIELD: THE UNIVERSITY.

Armstrong, F. E., professor of mining, Red Cross.
Bartlett, A. W., assistant-lecturer in botany, private, 3rd East Anglian Field Ambulance.
Duffield, Dr. F. A., demonstrator in experimental physiology, Lieut. R.A.M.C.
Glauert, Dr. E. C., demonstrator in metallurgy, Lieut. 2/4th Batt. K.O.Y.L.I. (T.F.).
Jarrard, W. J., assistant-lecturer in chemistry, Capt. 12th Batt. York and Lancaster Regiment.
Kenner, Dr. J., assistant-lecturer in chemistry, Capt. 12th Batt. York and Lancaster Regiment.
Lightfoot, B., Sorby research fellow, Staff-Lieut. Royal Engineers.

SOUTHAMPTON: UNIVERSITY COLLEGE.

Baldwin-Wiseman, R., lecturer in engineering, Capt. 3/5 Hants.
Marle, E. R., lecturer in chemistry, Corpl. R.E.

STOCKPORT: TECHNICAL SCHOOL.

Wood, G., lecturer in engineering department, 2nd Lieut. Worcester Regiment.

SWANSEA: TECHNICAL COLLEGE.

Coe, H. I., head of metallurgy department, 2nd Lieut. 18th Welsh Regiment.
Cranage, H., lecturer in telegraphy, Lieut. Royal Engineers.
Quick, H. E., lecturer in zoology, Lieut. R.A.M.C.

TEDDINGTON: NATIONAL PHYSICAL LABORATORY.

Bell, A. H., private, Civil Service Rifles.
Blackie, A., 2nd Lieut. London Electrical Engineers.
Bramwell, F. H., Lieut. Royal Naval Volunteer Reserve.
Eastland, W. H., private 6th East Surrey.
Ewen, D., private London Scottish.
Gough, H., sapper Royal Engineers.
Grogan, J. D., private Artists' Rifles.
Jolly, H. L. P., 2nd Lieut. Royal Engineers.
Kaye, Dr. G. W. C., Capt. London Electrical Engineers.
Landells, A., Lieut. Royal Naval Volunteer Reserve.
Masters, C. H., 2nd Lieut. 8th North Staffs.
Millar, G. H., signalman Royal Naval Volunteer Reserve (prisoner of war at Döberitz).
Powell, C. H., sapper R.N. Divisional Engineers.
Stedman, E. W., Lieut. Royal Naval Volunteer Reserve.
Strand, R. R., 2nd Corpl. London Electrical Engineers.
Studd, W. J. O., Lieut. Royal Garrison Artillery.
Sturgeon, H. C., private 6th East Surrey.
Tucker, N. P., 2nd Lieut. 2nd Cameron Highlanders.
Watts, S., sapper London Electrical Engineers.

TUNBRIDGE WELLS: TECHNICAL INSTITUTE.

Ainger, F. S., lecturer on commercial subjects, Lieut. 10th Royal Sussex Regiment.
Berry, J. D., lecturer on mathematics, private Public Schools and University Corps, Royal Fusiliers.
Blakeman, A., manual instructor, Corpl. Royal West Kent Regiment.
Cogger, W., lecturer on builders' quantities, etc., despatch rider.
Hannam-Clark, H. A., lecturer on telephony and electricity, etc., Lieut. Engineers (Telegraph Dept.).
Hearmon, L., arithmetic, etc., Sergt. West Kent Yeomanry.
Jones, B., practical mathematics and physics, private Public Schools and University Corps, Roy. Fusiliers.
Lunn, H. E., lecturer on experimental science, surveying, etc., Lieut. 9th Staffs Regiment.

UCKFIELD: AGRICULTURAL COLLEGE.

Goody, G. A., lecturer on estate management, Lance-Corpl.
Holman, A. E., soil chemist and soil surveyor, Lance-Corpl.
Upperton, A., analytical department (food and drugs), private.

WOLVERHAMPTON: TECHNICAL SCHOOL.

Ellis, J. R., instructor in pattern-making, Sergt. 1/6th South Staffs Territorials.
Murray, T. J., lecturer in chemistry, Sergt. R.A.M.C., 1/3 N. Midland Field Ambulance.
Price, W., lecturer in electrical engineering, Company Quarter-Master-Sergt. Royal Engineers.

WYE: SOUTH-EASTERN AGRICULTURAL COLLEGE.

Caukwell, C. A. B., milk recorder, Royal Engineers, Signalling Corps.
Charter, H. R., lecturer in chemistry, 7th East Surrey O.T.C.
Edwardes-Ker, D. R., head of chemical department, Capt. 5th Buffs (T.F.).
Fisher, E. A., research chemist, 2nd Lieut. Hants Royal Garrison Artillery.
Harvey, A., analyst, R.A.M.C. Sanitary Engineering Corps.
Hood-Daniel, A. F., lecturer in building construction, etc., 2nd Lieut. 5th Buffs (T.F.).
Ipswich, Viscount, lecturer in estate management, 2nd Lieut. 4th Batt. Coldstream Guards.
Jemmett, C. W., assistant entomologist, 2nd Lieut. 5th Buffs (T.F.).
Lefebure, V., research chemist, 2nd Lieut. 3rd Batt. Essex Regiment.
Reed, H. C., assistant analyst, Royal Engineers, London Wireless Signalling Corps.
Rothwell, S., lecturer in agriculture, Corpl. 5th Buffs (T.F.).
Smith, G., botany research, 2nd Lieut. 9th West Kent Regiment.
Spickernell, J. E., lecturer in chemistry, 2nd Lieut. 5th Buffs (T.F.).
Wellington, R., lecturer in fruit-growing, Corpl. East Kent Yeomanry.